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THE BATE REFRIGERATOR CASE.

We are informed by the clerk of the United States Supreme Court that the Bate refrigerator case has been advanced and assigned for hearing on Nov. 5, 1894. It will probably be two or three days after that date before it is actually argued, and at least two weeks, and perhaps several months, before the opinion will be delivered. As a consequence of this, the Edison lamp patent may expire under existing law before a decision is reached, but if the law is reversed in the Bate case this expiration will be nullified and the life of the patent extended to 1897.

STORAGE BATTERIES FOR POWER STATIONS.

In another column will be found an interesting account of a storage battery plant installed in the power station of the street railway in Zurich, Switzerland, which is of timely interest in view of the attention recently given to that subject in this country. The line is a comparatively small one, but it is with such lines that the use of storage batteries offers the most benefit on account of great fluctuations in the load. In the present case the considerable grades make these fluctuations greater than usual, so that we are not surprised to learn that the size of the generating plant is only half as large as would otherwise be necessary. In addition, the possibility of working the machinery somewhere near its point of maximum efficiency entails a saving in operating expenses which should also be no small matter. Our correspondent lays stress, and with reason, upon the care which the battery receives and the automatic arrangements for securing its most efficient working. To attempt to use storage batteries without the most minute care and attention to every detail would almost undoubtedly result in failure. It does not follow that this would entail a corresponding expense, but rather implies a most carefully thought out routine to begin with and then rigidly carried out. It would be the part of wisdom for a manufacturer in this country to refuse pioneer orders for storage batteries for central or power stations unless he is thoroughly convinced that they will be operated under proper conditions, as failures at the beginning would result in greatly retarding the general adoption of this useful auxiliary.

THE GOVERNMENT BRIEF IN THE BERLINER TELEPHONE SUIT

The brief of the counsel of the Government in the suit, now before the United States Circuit Court at Boston, for the annulment of the Berliner microphone patent, is quite breezy in tone and does not mince matters in its references to the Patent Office and its employes. It opens with the statements that the application for the Berliner patent dragged for years in the office for no apparent reason except an alleged probability of interference with some other application or applications, which, however, never materialized; that the application during its progress through the office disclosed remarkable transformations, and exhibited a process of evolution closely following the development of the art outside the Patent Office; and that the Commissioner of Patents, with the knowledge and acquiescence of the Bell company had finally proceeded illegally in the issue of the patent. Definite charges are made of "fraud, concealment, misrepresentation or deceit practiced by the applicant upon the Commissioner or the public," and of malfeasance and excess of power on the part of the Commissioner. It speaks of the innumerable delays in the Patent Office as a farce—"a farce in its ab-

surdity, but a Chinese tragedy in duration"—and the following indictment is not pleasant reading to those who have at heart the integrity of administration of our patent system: "No explanation can be given of these shameful proceedings in the Patent Office that will acquit the Commissioner from an imputation of corruption, or an indifference to the rights of the public which would be scarcely less criminal, except that he did not realize what was going on. The application was not before him personally, and it is only charitable to suppose that its existence, the character and scope of its claims, their relation to the art of telephony, and the effect which the delay in the grant of the patent would have in prolonging the monopoly of that art, were never present before his mind together, so as to give him a realizing sense of the gravity of the situation. As for the examiners, that excuse cannot be offered, or any other, unless it be that they had become so much the slaves of routine that they had no conception of duty, except to keep the applications in their hands rolling down ruts which had been worn by custom, and had become oblivious of all considerations of justice and right which exist apart from precedents and rules. * * The attitude of the Bell company toward these unwarranted and illegal delays was not only one of consent, but more, it was an attitude of interested consent, of assisting acquiescence, of guilty connivance. It knew that the Commissioner was betraying his trust—knew the practical effect of what he was doing far better than he did; it knew that it was its duty to stir him to action, but studiously refrained from doing so. Of all that was wrong in the business it was more guilty than the Commissioner. Can it hold beyond the reach of the law the fruit of that wrongdoing?" In addition to the charges of fraud and connivance, it is claimed that the patent is also void on the ground that the Berliner patent of 1880 describes the whole invention of the microphone exactly as it is described in the patent of 1891, the latter adding nothing to the description or claim except to broaden the scope of the latter. Further, it is contended that the transmitter of the patent is identical with the Reis transmitter of thirty years ago in its mechanical construction, being merely a make-and-break sound-transmitting telephone. The brief ridicules the statements of three ex-employes of the Patent Office, which are, respectively, that the Bell company was "urgent," "urgent and persistent" and "persistent in urging" that the patent be advanced; moreover, during the three and a half years prior to the issue of the patent and subsequent to the period referred to by these employes, it could have been issued at any time upon the demand of the Bell company. Referring to the issue of the two Edison microphone patents and the Berliner patent, the brief states: "The issue of this group of three patents in 1891 and 1892 upon applications filed in 1877, one covering broadly the mode of operation of the microphone, anothering covering broadly the only material known from which commercially operative and useful microphone contacts can be made, and the third a combination of material and mode of operation, is a circumstance fit to excite attention, and suggests irresistibly the presence of a premeditated design to postpone the issue of the patents in order to make them more valuable. Not one of them would have earned a cent for the Bell company at any time prior to March 7, 1893. It was foreseeable ten years ago that they might earn millions of dollars after that date." The conclusion of the counsel is, finally, that "the Bell company is seeking to perpetuate its monopoly of the art of telephony by means of a patent which not only ought not to have been issued as and when it was issued, but which has never been used and never will be." From the points of the brief we have quoted, it will be seen that the matter at issue goes beyond the Berliner patent, and is in effect largely an indictment of the Patent Office itself. The various charges made against the latter are so serious as to demand nothing less than an immediate and thorough investigation by Congress into its methods. The need of this is urgent, whether the delay of issue of the several telephone patents was secured by direct fraud, or through a lack of proper safeguards against the misuse of the machinery of the Patent Office by a great monopoly, or through an extraordinary system of circumlocution in itself responsible for the delay. No branch of public administration, not even that of justice, should be more above suspicion than the one relating to the granting of patents. The great publicity given to these charges against the Patent Office through the widespread interest in the Berliner suit, united to the fact that they are made by counsel for he United States Government itself, have already doubtless created a distrust in the integrity of our patent system, which is the more serious because by tending to discourage inventors it tends to blight what has been one of the most fruitful factors in our industrial growth.

An Entirely Unsolicited Opinion.

A gentleman whose views on electrical journalism and particularly on the subject of advertising are always welcomed, was moved by the spirit to write The Electrical World a personal letter on receipt of last week's issue, in which he said:

"Upon looking over the pages of The Electrical World of this week, its appearance, make up and especially the size of the advertisements, gave to my mind a better idea of what an ideal trade paper should be than any other publication of its kind I have ever seen. Having made it my business for over five years to watch and scrutinize the pages of all the electrical papers, the changes for the better, especially in The Electrical World, never struck me so forcibly as now. May be the reason was that I happened to look over an old copy of The Electrical World of 1884 when this week's issue was handed to me. The difference is remarkable. Then a great blanket sheet, clumsy in appearance and hard to handle. A few advertisements (very few, indeed), and most of them covering a whole page, while now a convenient sized publication, replete with interesting matter on the reading pages, arranged and systematized so as to appeal at once to every reader by the beauty of its make up. There seems to be a method exercised in the arrangement of The Electrical World of to-day, indicating that every item and every article or department has been placed in its position with the motive of making the whole an harmonious combination of the interesting events of the week in addition to the electrical field of the globe. But being more interested in the advertising pages than in the other portion, I must say that especial congratulations are due you on their account, not only for their large number but also for their arrangement."

An Ancient Dynamo.

Sir Frederick Bramwell, in a recent lecture, stated that the Holmes dynamo, with permanent magnets, which was tried experimentally as early as 1857, was still being used at last accounts, some three or four years ago, for generating electricity for the light in the South Foreland Lighthouse.

English Journalism.

The fact that Goebel claimed to have anticipated Edison in the invention of the incandescent lamp seems to have only quite recently reached a well-known English engineering journal, as the "news" is published in the issue of June 1 of this year. The news that Goebel died some time ago may be looked for in that journal some time in 1895 or 1896.

Molecular Energy.

According to G. F. Fitzgerald, a hydrogen molecule moving with the velocity of light has an energy of less than half a millionth of an erg.

SWITZERLAND AS THE PRESENT ELECTRICAL CENTRE OF EUROPE

BY FREDERICK BATHURST.

THE ZURICH-HIRSLANDEN ELECTRIC RAILWAY.

Whilst there are already installed in different parts of Switzerland isolated examples of overhead electric railway systems, intended mainly for the transportation of a summer tourist traffic, there are none, the writer believes, either in Europe or the United States that present the points of interest contained in the one it is now proposed to describe. This road, running from the centre of the town of Zurich to an outlying suburb, Hirslanden, was opened to the public in the beginning of the year, and is, it is thought, the precursor of the development that may now be expected in many other Continental towns.

Zurich has, of late years, vied with an ordinary American town in the rate at which its population is increasing and the way in which new residential suburbs have sprung into existence. Formerly a long, straggling city, built upon both sides of the River Limmat, starting from the point where the lake outflows, the town now covers all the surrounding hills, so that it has become nearly circular in form.

This growth has necessitated a reconsideration of the "rapid transit" facilities and resulted in the projection of another addition to the modern Juggernaut of electric street railways. To prejudge from its present operation, this road will form a practical proof of the question long mooted in the United States as to the desirability of the use of accumulators in the power house.

As before referred to in this series of articles, the cost and difficulty of obtaining an adequate coal supply is the incentive driving Swiss engineers to the consideration of the best electrical practice, and without the inducement and promise of economy to be effected in coal consumption by the use of accumulators, it would have been impossible to show a prospective profit for this road and present the scheme to business men as a lucrative investment. Receiving, however (from the makers of a secondary battery of established reputation), a guarantee by which the cost of maintenance became a definite quantity, the road has been equipped and put into successful operation.

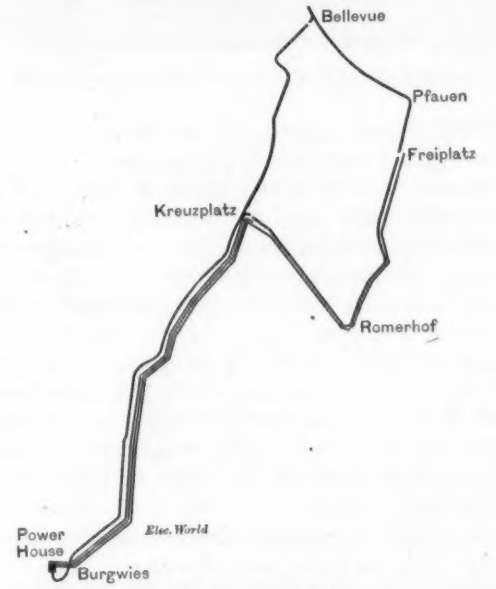
The ground plan of the road (see cut) resembles in form a reversed nine, consisting of a tolerably straight length of track from Bellevue to the power house with a detour branch by Pfauen and Romerhof, returning to the main line at Kreuzplatz.

From the map of Zurich it will be seen that Bellevue is in the centre of the town, upon the lake front and at the end of the magnificent Uto promenade by the Quai Bridge, so that passengers landing from the lake steamers can at this point have immediate access to what may eventually be the complete town system.

The power house is situated outside the town at the Hill of Burguris, two miles distant, in the suburb of Hirslanden.

The profile plan, giving percentage of grades and their length in meters, will show that the road is a continual ascent from Bellevue to the power house end. The power house was located here on account of the cheapness of real estate and the accessibility of a water supply for condensing purposes.

The plan and general view of this building are shown in the illustrations. It will be noted that it is a combination

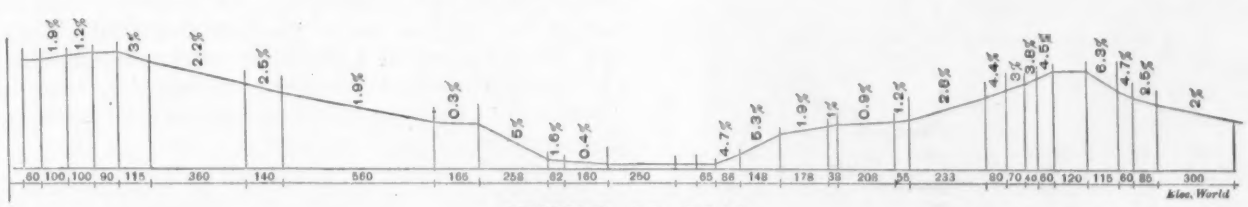


MAP OF ROAD.

construction of engine room and car barn under the same roof. Provision is made for the ultimate equipment of the road—18 cars.

The accumulator house is also included, being situated at the back of the engine room; in fact, the division is such that the cars take up about one-half of the total space available, the division wall being laid longitudinally, and the remaining half nearly equally divided among offices, engine room, accumulators and boilers. Everything is on the ground floor, the lighting being very effectively achieved by glazing the roof. The graceful chimney stack forms a landmark for miles around, and stands as an index of the substantial construction of the whole plant.

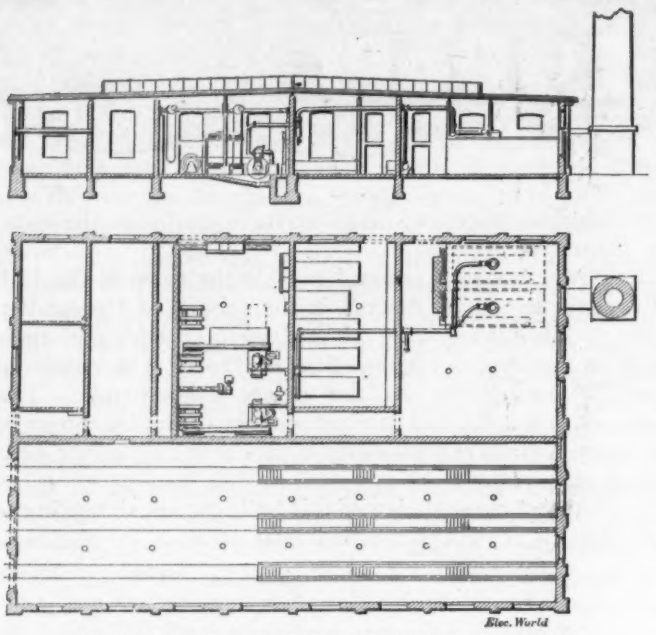
An idea of the interior of the engine room can be obtained



PROFILE OF ROAD.

from the cut. There are three vertical type compound condensing engines (Oerlikon type), two of 100 indicated horse power each and a smaller one capable of indicating 45 h. p.

The crank shaft of the two larger engines sets very low in the foundations, and each has a wheel pit, so that the flywheels on them can be belted directly on to the generator

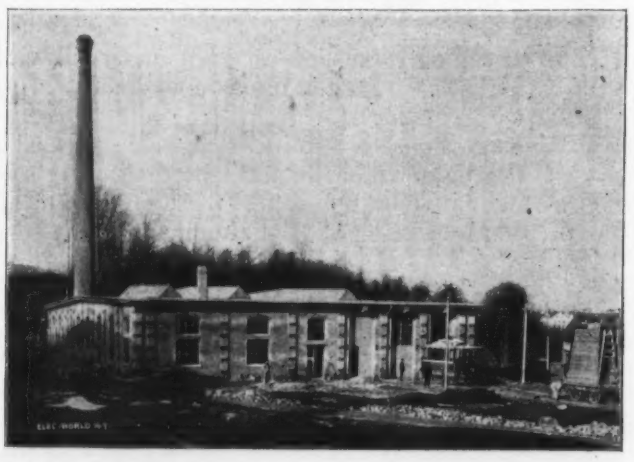


PLAN AND ELEVATION OF POWER HOUSE.

pulleys. These engines run at 240 revolutions per minute, the generators at 450 revolutions per minute.

The generators, also by the Oerlikon works, are four-pole ironclad machines, have external field frame Gramme ring armatures and a capacity of 66 kw. They are specially designed as shunt machines for running in connection with the accumulators, but are provided with additional series field windings, so that they can, if necessary, be run upon the line as an ordinary compound wound generator. This provision adds to the certainty of operating the road, even supposing it was requisite to cut-out the accumulators. Under ordinary running conditions the output at 450 revolutions is 120 amperes at 550 volts, only one generator at a time being run and the other held as reserve.

The small engine is coupled direct to an auxiliary four-pole generator, this set being used for charging the "extra"



EXTERIOR OF POWER HOUSE.

cells of the battery. Space is left for additional engines when the equipment is extended to 18 cars.

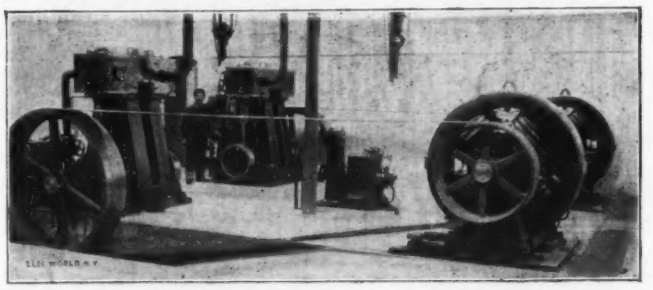
The boilers are of the Galloway type, installed upon the Escher Wyss system.

Every attention has been given to convenience of operation, so that one attendant can satisfactorily take charge of the engine room.

Among details of equipment one notices the provision of overhead travelling cranes. The neatness of the station and absence of unsightly electric cables are also remarked, and there is a point in European practice which might well be copied more often than it is—all the cables are taken downward by the side of their machines into troughs or channels provided in the floor. They then pass into a common conduit, and, supported upon porcelain insulators, find their way toward the switchboard. The conduits have removable iron covers, constructed in convenient lengths, so that any part of the wiring can be inspected at a moment's notice.

At one end of the engine room two switchboards are placed, one being of the usual street railway type, containing main switches, feeder cut-outs, lightning arresters, etc., the other being specially designed to suit the peculiarity of this station.

On this—the accumulator switchboard—are arranged the "high" and "low" voltage relays, ammeters and discharging switches for the battery which forms the direct source of power to the line. All the regulation on this board is automatic. The most conspicuous apparatus (see cut) is the circular switch, which cuts in and out the cells to suit any variation of the line voltage. It is very interesting to watch the operation of this "cell regulator switch," the contact arm of which, actuated from behind by two solenoid magnets acting by reverse pawls upon toothed wheels, swings around the contact plates in either direction with continued and unerring accuracy. The switch was designed and made by the Oerlikon works. The board also contains a "minimum cut-out," operating to disconnect the generators whenever the charging current from the generators falls below 10 amperes. A polarized cut-out and a 2-volt voltmeter for the additional cells are referred to later.



A VIEW IN THE ENGINE ROOM.

In the battery room, supported to wooden frame tiers upon insulators, there are 300 Tudor type secondary cells, made by the Hagen company, of Germany. They have been installed upon a 10 years' contract agreement, by which the makers become entirely responsible for their operation and maintenance. Of the 300 cells, connected in series, 240 constitute the battery proper, and are always in parallel circuit to the generators; the remaining 60 cells are used for regulating purposes, and through the circular switch are put in and out of the line circuit, as required. Each cell has a normal capacity of 245 ampere hours with an 80-ampere discharge, although 160 amperes can be taken momentarily without damage. The battery, as a whole, is rated as capable of giving 120 amperes at 550 volts, and is estimated as being able to run the line with nine cars upon it for 1 1-2 to 2 hours independently of the generators.

The function of the 60 additional cells being of the utmost importance, very complete arrangements have been made for their preservation. For at least one hour every day, generally at the time when least load is on the line, the small direct connected generating set is started up and charges the regulating cells independently of the remainder of the battery. The generator is specially wound, so that its output is 20 amperes at 150 volts and 30 amperes at 100 volts. The state of each individual regulating cell can be determined at any time from its indication on the 2-volt voltmeter.

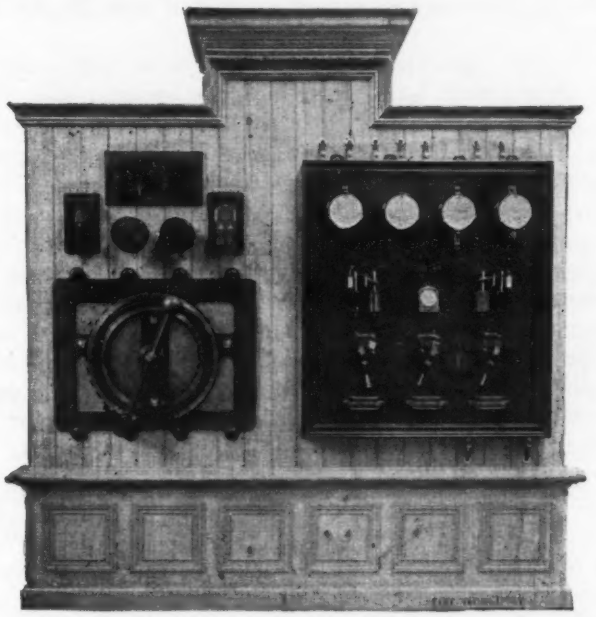
As a rule, at the end of the day's run, the extra cells are found to be "run down" and the attendant determines how long it is necessary to run the small generator so as to bring them back again into good condition, this machine providing that as their voltage rises its charging current decreases.

It is found that the average current output from the station, with nine cars on the track, is 90 amperes, although the momentary fluctuations may vary from 0 to 200 amperes.

With the former condition, the whole of the current output from the generator passes into the battery for storage, while in the latter condition the generator supplies the line with 120 amperes and the battery makes up the deficiency of 80 amperes.

Load variations may cause variations in the speed of the engine, amounting to 2 per cent. or 3 per cent., and the question as to the source of supply at a certain moment of overload depends upon whether the cell regulation or that of the generator responded the quicker.

The function of the cells is to take this peak of the load, so that an economy can be effected in the size and first cost of the engine, generators and steam equipment. It will be apparent that the use of accumulators in this particular case makes it possible to run on half the size plant otherwise necessary. Only one generator set need run continuously, so that the steam required, even for running the other one light, is saved perpetually, and there is the additional gain where at such times both generating sets would have to be running uneconomically on small loads.



ACCUMULATOR SWITCHBOARD.

Coal in this plant costs 30 francs per ton and has usually to come from Germany.

The road is a severe one, the up grade being practically continuous from the lake front to the power station, and presenting stretches of 2 1-2 per cent., 3 per cent. and 5 per cent. grades, 500, 300 and 140 metres long, respectively. The steepest grade is 6.3 per cent., 115 metres long, on the detour branch upon the return to Kreuzplatz. The track, laid on a one metre gauge, has a total length, not including turnouts and lengths of double track, of 4.6 kilometres. The curves, with the exception of the sharp one at Romerhof, are ordinary.

A rail of the girder type, weighing 70 pounds per yard, is employed throughout. The dimensions are:

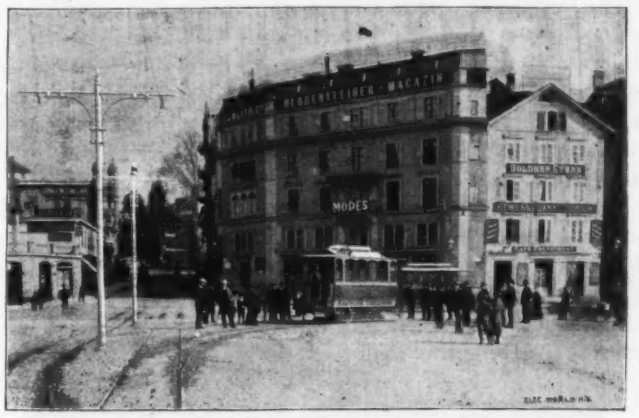
Width of web at foot.....	125	millimetres	= about 5		inches
Height from web to tread.....	140	"	= "	5½	"
Width of wheel tread.....	40	"	= "	1⅝	"
Width of flange opening.....	30	"	= "	1⅛	"

The rails are laid directly upon the ground, mostly macadam or hard limestone roadbed, with tie spacing pieces every 10 feet.

The jointing is effected with the ordinary fish-plates on either side of the girder, but cement blocks are placed under the break in the web.

Every joint is bonded electrically with copper bonding wire, having riveted ends. A copper earth wire 7 millimetres diameter (No. 1 B. & S.) is laid throughout the track and connected to each bonding wire.

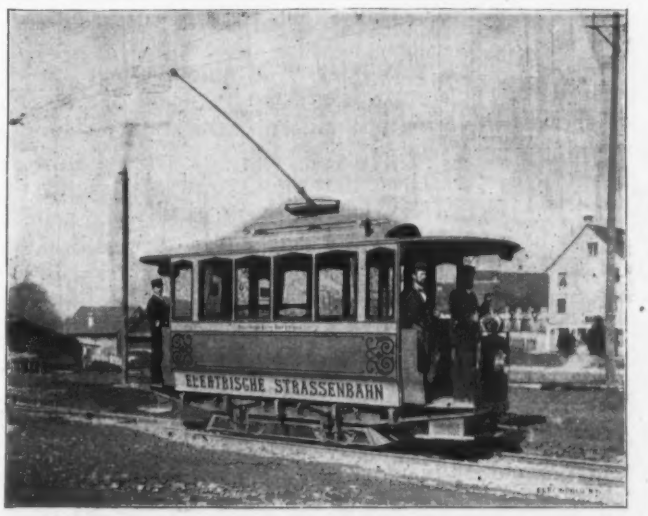
Iron and wood poles are used for supporting the trolley and feeder wires, the former being used in the town as centre poles, the later being used on the outskirts and mainly for cross suspension. The iron poles are made from three lengths of steel tube 3, 4 and 5 inches diameter, shrunk together, whilst the bracket, or cross-arms, are made from 1 1-2-inch pipe. Stranded steel wire suspension and straining cable 8 millimetres diameter (No. 0 B. & S.) is used throughout.



CENTRE POLE CONSTRUCTION IN THE TOWN.

Above is shown a portion of the track construction in the town near the lake front.

The trolley wire, 7 millimetres diameter (No. 1 B. & S.), is of hard drawn copper and supported by insulators of the American type; in fact, "Aetna" insulation blocks and bolts have been obtained from the "Hub of the Universe." Boston type trolley switches are also employed.



THE CAR.

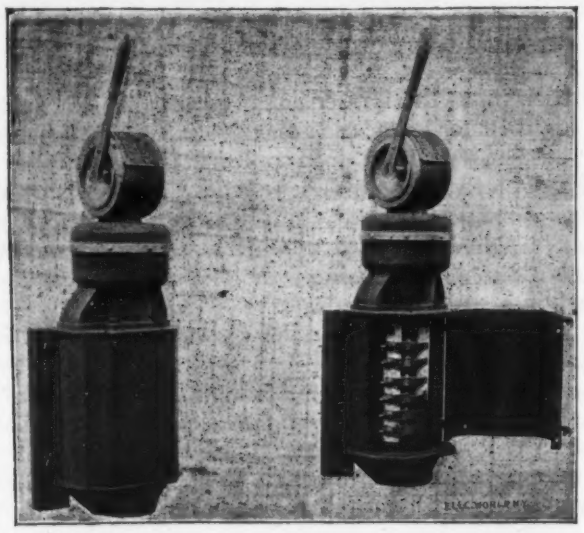
The line is divided into four sections, the town portion having three separate feeders (see map), whilst the outlying section is fed direct from the trolley. Total length of feeder wire is four miles. Greater care is taken in the insulation of the trolley and feeders than usual, as many as three distinct insulating blocks being placed between line and earth,

Each car truck is equipped with one 15-kw. single reduction street car motor very similar to the present G. E. No. 800 motor. The armature runs at 450 revolutions, the ratio of reduction is 1 : 4.9. The soft steel gear has a 4-inch face and the pinion is hardened steel. The weight of the motor complete is 950 kilogrammes (2,100 pounds), the weight of the car equipped ready for service is 3.8 tons.

Twenty-six passengers form a normal load. The average running speed attained on the line, inclusive of stoppages, is 12 kilometres (7 1-2 miles) per hour, but a speed of 20 kilometres is obtained on those level stretches where it is necessary to make up time.

The handsome car is shown in a view which also gives an idea of the truck arrangement and the safety netting and fenders by which the wheels are completely surrounded. The inside of the car is finely finished in American bent wood, and if an attractive looking, clean and well lighted interior is the inducement to increased patronage, the success of this line must have already been secured.

The controller, as seen below, is the same in effect, though rather different in form, as that usually employed. The handle is operated by a forward or backward horizontal motion instead of a rotary one. Current is "off" when the handle stands in a vertically upright position. It is claimed that this movement is easier for the motorman. The form is



CAR CONTROLLER.

compact and allows a convenient arrangement of the blow-out magnet. The control is effected by means of a resistance in series with the armature and an extra shunt or loop coil on the motor field.

It may be useful to note that the Continental practice in respect to the street car gong or alarm is to place a bell on the brake handle, so that the driver can operate brake and bell at the same time, and when on this road the ear-piercing foot gong, so familiar in American practice, was first introduced, it was the subject of long and bitter complaint from the quiet loving inhabitants of the town. Even now it is only on probation.

This road, so recently opened as the 1st of March, has followed the regular precedent and attracted to it during the first three weeks of its opening an enormous traffic of pleasure riders, enough to insure a dividend for the first six months' operation, and so far elate the shareholders that they have held meetings to consider the advisability of obtaining extensions to their franchises in the town.

Much credit is due to Messrs. Huber and Kolben, of the Oerlikon works, who, working upon the experience of American street railways, have been the first to put into successful operation this accumulator plant, and although it is too soon at present to offer reliable data as to the efficiency of its operation, undoubtedly many of those interested in this extensive branch of industry will await with lively concern the publication of the experience and figures gained by the engineers of this road.

Leaving it to those better fitted to pass judgment as to whether Switzerland may or may not be designated the present electrical centre of Europe, the writer would now apologize for having, at such length, endeavored to present descriptions of plants which to him appear typically illustrative of the advanced state of Swiss electrical practice.

Reactance.*

BY CHARLES PROTEUS STEINMETZ AND FREDERICK BEDELL.

The term "reactance," which has been used and advocated by writers and others and which has been officially adopted at our suggestion by the American Institute of Electrical Engineers at its Philadelphia meeting, is one which assumes particular importance now that the term "inductance" is defined as synonymous with the "coefficient of self-induction," usually symbolized by the letter "*L*." Reactance is a quantity similar in many respects to resistance, but the electromotive force used in overcoming reactance consumes no power, for it is at right angles to the current.

The impressed electromotive force in an alternating current circuit may be divided into two components: First, the *power electromotive force* in the direction of the current, and, second, the *reactive electromotive force* in quadrature with the current to overcome the reactance. The reactive electromotive force is the product of the current and the reactance. *The reactance is, accordingly, equal to the component of the impressed electromotive force at right angles to the current, divided by the current.* Reactance is measured in ohms.

The reactive electromotive force in the circuit may be due to self or mutual induction, to capacity or to some outside counter electromotive force produced by a motor or other device. In general, in any alternating current circuit,

$$\text{Impressed E. M. F.} = \sqrt{\text{Power E. M. F.}^2 + \text{Reactive E. M. F.}^2};$$

that is, the impressed electromotive force is the vector sum of the electromotive force which transmits power and the reactive electromotive force.

Reactance tends to cause a phase difference between current and electromotive force. If θ represents this angle of phase, we have the relation,

$$\tan \theta = -\frac{\text{reactance}}{\text{resistance}}.$$

When θ is negative, the current lags behind the electromotive force; when θ is positive, the current is in advance of the electromotive force. The expression for the instantaneous value of the current may be written,

$$i = I \sin (\omega t + \theta).$$

or

$$i = \frac{\text{Impressed E. M. F.}}{\text{Impedance}} \sin \left\{ \omega t - \text{arc tan} \frac{\text{reactance}}{\text{resistance}} \right\}.$$

A few illustrations of particular cases will make the use of the term reactance more clear.

Circuits Containing Resistance and Inductance.—In a simple circuit containing resistance and inductance, the reactance is equal to $L\,\omega$; that is, it is $2\,\pi$ times the product of the inductance and frequency. The impedance being the vector sum of the resistance and reactance, is

$$\text{Impedance} = \sqrt{R^2 + L^2\,\omega^2},$$

where $\omega = 2\,\pi \times$ frequency. In this case all the power is used in overcoming resistance, and the power electro-

* A paper presented at the close of the Philadelphia meeting of the American Institute of Electrical Engineers, May 18, 1894.

motive force is equal to the ohmic electromotive force RI. The reactive electromotive force is equal to the inductive electromotive force $L\,\omega\,I$; hence

Impressed E. M. F.

$$= \sqrt{\overline{\text{Power E. M. F.}}^2 + \overline{\text{Reactive E. M. F.}}^2};$$

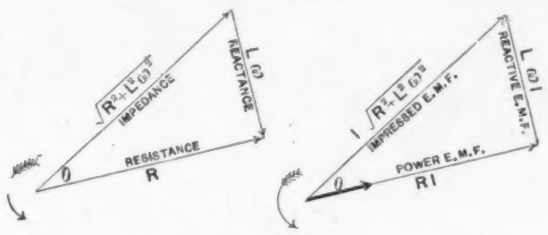
or

Impressed E. M. F.

$$= \sqrt{\overline{\text{Ohmic E. M. F.}}^2 + \overline{\text{Inductive E. M. F.}}^2}.$$

The impressed electromotive force in this case is the vector sum of the electromotive forces necessary to overcome resistance and inductance.

A consideration of Figs. 1 and 2 (in which positive direction is counter clockwise) will show that the reactance and



FIGS. 1 AND 2.

reactive electromotive force are *positive* in the case of a circuit containing inductance. The impressed electromotive force, which is the sum of the two, is therefore in advance of the current, which is in the same direction as the power or ohmic electromotive force. The current is indicated by a closed arrow in the figures. The same, however, may be otherwise expressed if we take the impressed electromotive force as our direction of reference, by saying that the *current lags behind* the electromotive force by the angle θ, which angle is negative, therefore, for circuits with inductance according to the relation

$$\tan\,\theta = -\frac{\text{reactance}}{\text{resistance}} = -\frac{L\,\omega}{R}.$$

The value of the current at any instant is given by the equation

$$i = \frac{E}{\sqrt{R^2 + L^2\,\omega^2}} \sin\left(\omega\,t - \text{arc tan}\,\frac{L\,\omega}{R}\right).$$

Circuits Containing Resistance and Capacity.—In such circuits the reactance is equal to $-\frac{1}{C\,\omega}$, where C, capacity, and $\omega = 2\,\pi \times$ frequency, that is, it is negative. The reactive electromotive force is also negative, being equal to $-\frac{I}{C\,\omega}$. This negative reactance gives a positive value to the angle θ, and the current is accordingly in advance of the electromotive force. We have then

$$\text{Impedance} = \sqrt{R^2 + \frac{1}{C^2\,\omega^2}},$$

and

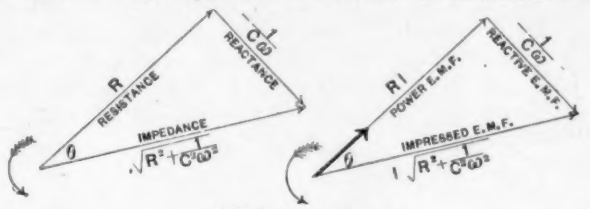
$$\tan\,\theta = -\frac{\text{reactance}}{\text{resistance}} = +\frac{1}{C\,R\,\omega},$$

similar to the corresponding equations above. The instantaneous value of the current is given by the equation

$$i = \frac{E}{\sqrt{R^2 + \frac{1}{C^2\,\omega^2}}} \sin\left(\omega\,t + \text{arc tan}\,\frac{1}{C\,R\,\omega}\right).$$

These relations are shown in Figs. 3 and 4.

Circuits Containing Resistance, Inductance and Capacity.—In a circuit containing inductance and capacity the reactive electromotive force is the sum of the inductive electromotive force and the condenser electromotive force; that is, $\omega\,I - \frac{I}{C\,\omega}$. The reactance is similarly the sum of two terms, $L\,\omega - \frac{1}{C\,\omega}$; thus, the reactance is positive or negative, according to whether the inductive electromotive force is greater or less than the condenser electromotive force.



FIGS. 3 AND 4.

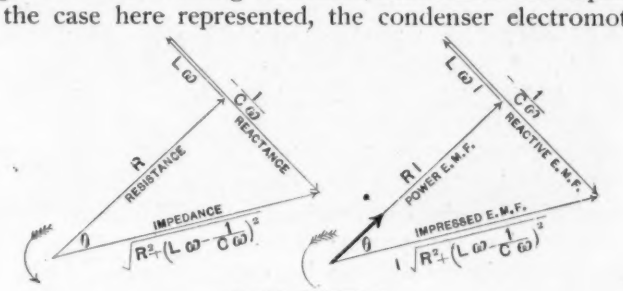
Whether the current is behind or ahead of the impressed electromotive force depends upon the same condition, for

$$\tan\,\theta = -\frac{\text{reactance}}{\text{resistance}} = \frac{1}{C\,R\,\omega} - \frac{L\,\omega}{R}.$$

The value of the current at any instant is

$$i = \frac{E}{\sqrt{R^2 + \left(L\,\omega - \frac{1}{C\,\omega}\right)^2}} \sin\left\{\omega\,t + \text{arc tan}\left(\frac{1}{C\,R\,\omega} - \frac{L\,\omega}{R}\right).\right\}$$

The diagrams in Figs. 5 and 6 illustrate the case of a single circuit containing resistance, inductance and capacity. In the case here represented, the condenser electromotive



FIGS. 5 AND 6.

force is greater than the inductive electromotive force, and the current is therefore in advance.

Circuits Containing Mutual Induction.—To further exemplify the use of the term reactance, let us consider a circuit containing a transformer. Besides the electromotive forces already discussed, we must consider the back electromotive force due to the influence of the secondary upon the primary circuit. This may be resolved into two components, one in the same direction as the current, and the other in quadrature with it, which will form part of the power electromotive and reactive electromotive forces, respectively. The electromotive force introduced by a motor is treated in the same way.

These illustrations will suffice to show the method by which any electromotive force in a circuit is resolved into two components, one in the direction of the current, which therefore transmits power, and the other at right angles to the current, which represents no power but simply overcomes the reactance.

It is to be borne in mind that the terms here given may be used in all alternating current circuits, whether the current is harmonic or not; for, when the current is not strictly harmonic, we may consider it equivalent to an harmonic current. The *equivalent* harmonic current and equivalent harmonic electromotive force have the same square root of mean square values as the actual current and electromotive force, and have such relative phase positions that the same power is transmitted.

Reducing the Size of the Earth.

The results of the recent races at Derby were received by cable in New York City only a few seconds later than in London.

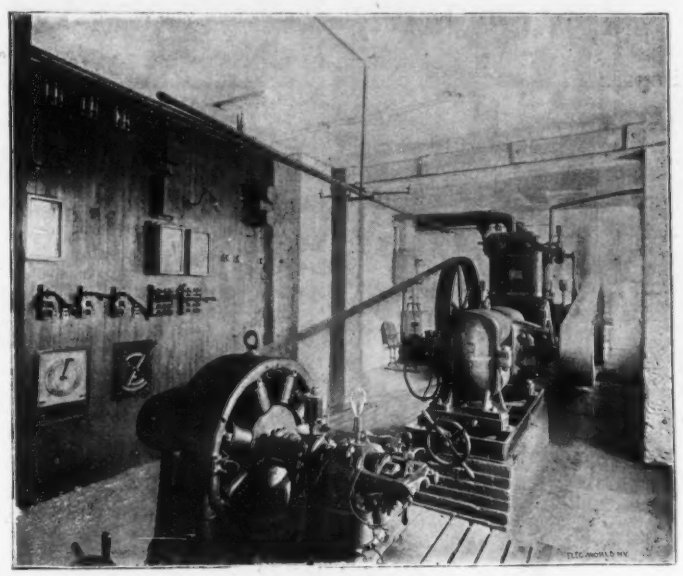
Western University of Pennsylvania's Electrical Engineering Course.

The Western University of Pennsylvania is probably best known through its observatory, commonly known as the Allegheny Observatory, where Prof. Langley made his celebrated researches on radial heat, and on aero-dynamics. It was here that the bolometer was invented and the infra-red spectra of the sun and other sources of radiant energy were first mapped out. Although the university is comparatively an old institution, having been incorporated in 1819, it was not until quite recent years that any attention was given to the engineering branches, and this, in spite of the fact that it is situated at one of the largest manufacturing centres in the world. In 1882 a chair of civil engineering was founded, and filled by Prof. Carhart, the author of several well-known text-books. In 1892 a chair of mechanical engineering was created, which was filled by Prof. Stewart, and in 1893 one of electrical engineering, which was filled by Prof. Fessenden, formerly professor of electrical engineering at Purdue University.

The accompanying illustrations show views of the main building of the university, of the temporary dynamo-room, and of the temporary electrical laboratory.

Although, as mentioned above, the electrical laboratory is only a temporary one, it is well equipped, especially in the direction of exact electrical measurements. Four thousand dollars was invested in electrical instruments of the highest class last fall, bought from the Weston Instrument Co., White & Co., Nalder Bros., and Queen & Co. In addition to the amount mentioned above as invested in the finer instruments, a quantity of rougher apparatus was bought, or constructed in the university shops, and the laboratory furnished with two dynamos and a number of motors.

Among the finer apparatus may be mentioned ten Weston instruments, including one laboratory standard voltmeter; Kelvin balances, reading from a few centiamperes to eight hundred amperes; a Kelvin wattmeter, two Carhart-Clark cells, three standard ohm coils, in platinoid and constantin; specially designed Carey-Foster commutator and conductivity bridge, Ayrton-Perry secohmmeter and standard of self-induction, other standards of self-induction and capacity, Anthony bridge (from exhibit of Queen & Co. at the World's Fair), range from 1-1,000,000 ohm to 111,000,000 ohms; Lummer-Brodhun photometer; Sartorius balance with weights compared with Berlin bureau of weights and measures (as was determined very accurately by the U. S. surveys for Allegheny, this enabling accurate measurements of mass to be made), dividing engine and comparator from the Societe Genevoise, Ayrton-Sumpner, Ryan and Kelvin electrometers; ballistic, D'Arsonval and other galvanometers;

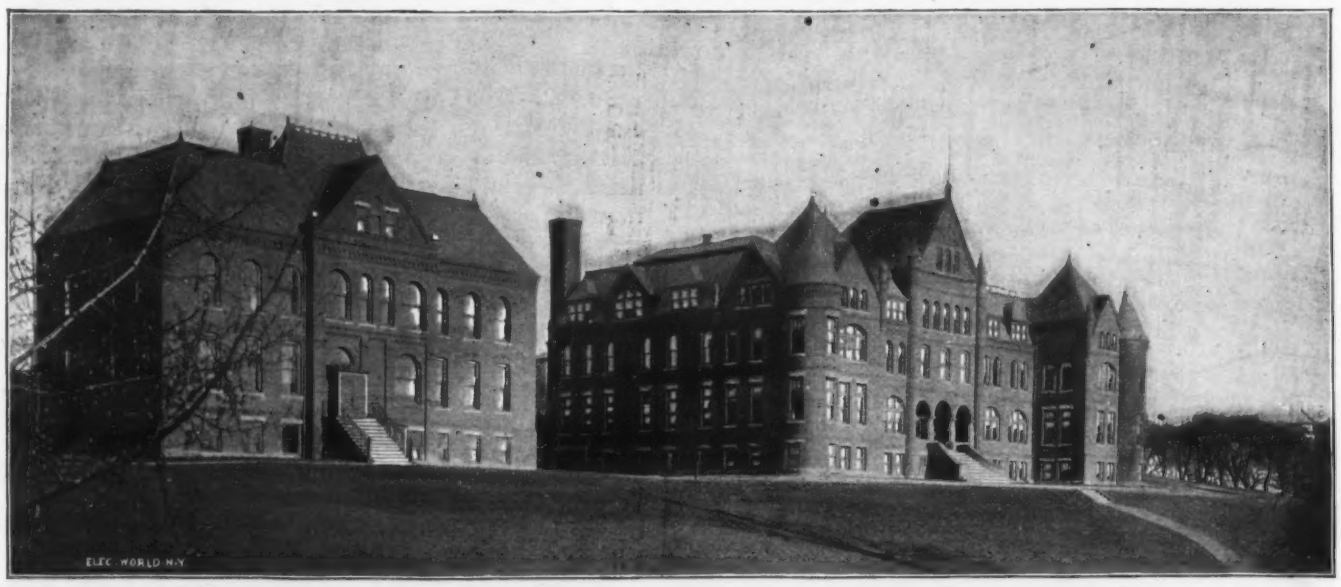


DYNAMO ROOM.

portable testing sets, dynamometers, storage batteries, instantaneous contact apparatus, etc.

The course is, as usual, a four year one, the first two years being about the same as most technical colleges. The shop work includes woodworking, blacksmithing, pattern-making, founding and machine shop work. One foreign language is required from engineering students. In the junior year, the electrical engineers take up the electric, magnetic and dielectric circuits; electro-chemistry, with special reference to thermo-chemistry, and practical testing work in the laboratory with Weston instruments, such as localization of faults, insulation tests, standardizing instruments, etc. In the second half of the year, the course comprises dynamo-machinery, dynamo design, differential equations, and testing work on dynamos and motors.

In the first half of the senior year Bedell and Crehore's "Alternating Currents," and Emtage's "Mathematical Theory of Electricity" are completed, with advanced laboratory work and absolute measurements and experiments on A. C.

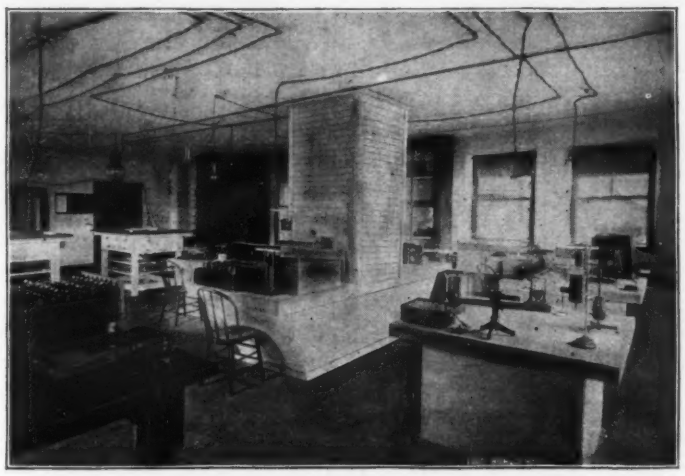


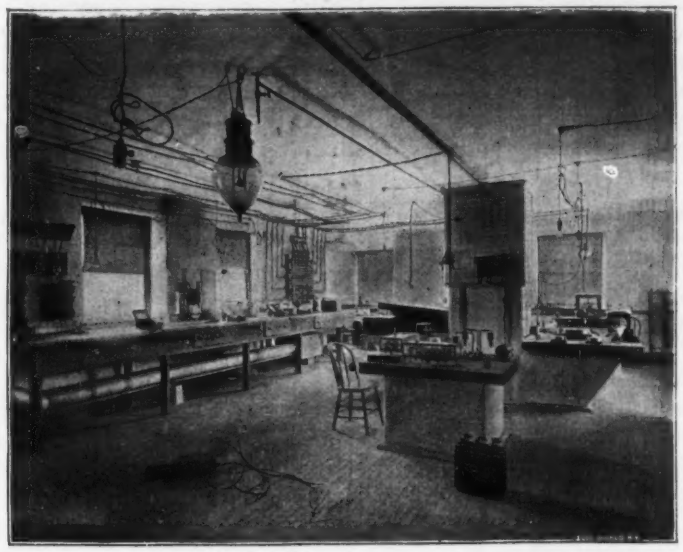
MAIN BUILDING, WESTERN UNIVERSITY OF PENNSYLVANIA.

circuits. In the second half of the year, the second volume of Fleming's "Alternating Current Transformer," transformer and station design, estimates on electrical construction, polyphase curents, a short practical course on modern vector methods, and similar subjects. During the senior year each pair of students is required to make the principal working drawings of two of the following: direct-current dynamo or motor, A. C. dynamo or motor, transformer—from original designs.

Thermodynamics, steam-engine design, mechanics of materials, graphical statics, engine and boiler tests and other engineering subjects are taken up during the junior and senior years.

It will be seen that the university has many advantages for the performance of high-class research work, and the neighborhood of the Westinghouse Electric Company, the Carnegie Steel Works and other large engineering works renders it particularly suitable for the location of a university where engineering studies are to be carried on.





VIEWS IN THE ELECTRICAL LABORATORY.

The attention of the citizens of Pittsburgh having at last, through the efforts of Dr. Holland and some of the trustees, been called to the advantages of having a technical school of high standing in the neighborhood, it is now proposed to build and equip suitable engineering laboratories and shops. The sum of $500,000 is now being raised for this purpose, and $160,000 has already been secured. An electrical laboratory will be built and equipped with the most approved apparatus and machinery, at an estimated cost of $150,000.

Electrical Smelting in Germany.*

BY FRANK H. MASON.

Among the recent German inventions in metallurgy, one of the most interesting, by reason of its simplicity and its probable value in practical application, is a process invented by Mr. Edward Taussig, of Bahrenfeld, for the smelting and casting of metals by electrical heat, under the influence of rarefied air.** The operation consists in fusing ores or metals in a closed furnace or chamber, the hearth of which is connected with moulds into which the fused metal flows by gravitation, and is cast into any desired form, and in both of which (moulds and furnace) the air has been rarefied as far as practicable through exhaustion by air pumps or other mechanical means.

The apparatus includes a long, air-tight smelting channel or chamber, the hearth of which inclines to a central orifice, through which the fused metal passes into the moulds. This chamber is filled with the metal to be smelted, and heat is generated by passing an adequate current of electricity through the mass without the use of any kind of fuel, or the employment of carbon electrodes. In this latter respect, the inventor of this process claims that it is entirely original and distinct from all other electrical smelting systems now in use in this country.

The furnace is lined with glazed fire-bricks, which are so efficient a non-conductor as to insulate quite perfectly the contents of the chamber, so that the heat is developed where it is required evenly throughout the mass, and very little, if any, loss of current is experienced. From the testimony of experts who have examined this process in operation, it appears that a degree of heat sufficient to smelt pig iron in 15 minutes can be generated and maintained without unduly heating the other parts of the circuit, and this is equally true of the smelting of easily fused metals like lead and zinc, and of Siemens-Martin steel of Swedish origin, which is known to be one of the most refractory of all the useful metals.

The entire absence of coke, coal, or carbon electrodes secures to the fused metal nearly absolute purity, and the continued exhaustion of air and the gases generated by smelting increases the fluidity of the molten material and wholly prevents oxidation and blistering and produces castings of a dense, smooth quality, which have shown, under elaborate tests made by unimpeachable authority, the highest mechanical qualities of which cast iron is capable.

Without attempting to estimate the practical value of this process or its future range of application, it is fairly within the province of the present report to consider what may be reasonably inferred as to the limitations by which the industrial process will be restricted, and its probable economic efficiency for smelting and casting. For smelting raw ores, the most obvious advantage claimed for it is that it can be worked wholly by water power and without fuel in mountainous and remote districts which produce ores and have abundant water, but no coal.

For fusing iron, steel, or other metals for casting purposes, the advantages claimed are rapidity of operation, improved quality in the castings, susceptibility of continuous working, and—even where steam power is used to generate the current—an economy of fuel which is estimated at from

*Report of U. S. Consul-General at Frankfort.

** In transmitting his report, Consul-General Mason says: "It is believed that this process, which is not yet patented in the United States, may have a practical interest for many foundry men and producers of iron and steel in our country. In this connection, it may be of interest to know that the American patents for the Otto-Hoffman system of coke manufacture, with saving of the by-products, have recently been purchased by a syndicate organized at Pittsburgh and Cleveland, which is preparing to establish extensive works under that system at several localities in the United States."

30 to 50 per cent. of the coal used in smelting by the ordinary method. From what has been already stated, it would appear that the practical limit of capacity will be a furnace or fusion channel from 36 to 40 feet in length, and capable of containing at one charge about one and one-half tons of metal. By working such a furnace with a current of 30,000 amperes and 50 volts—which would represent a force of about 2,000 h. p., or somewhat less than the energy employed in the reduction of aluminium at Neuhausen—the entire charge of 3,000 pounds can be fused and run into castings within a quarter of an hour. By repeating the operation as rapidly as the charge can be replaced and smelted, a single furnace of this capacity can be made to turn out in a working day a large quantity of castings, and when motive power for generating the current is supplied by water, or even by steam made with a low, cheap quality of coal, the economy of the process over present methods would seem to be obvious.

Comparisons have been made with the well-known results of making iron and steel castings by smelting in a Siemens-Martin regenerative furnace, where from 1,000 to 1,400 pounds of coal are burned to smelt 2,000 pounds of iron. Assuming that water power for the Taussig process is not available, and that the dynamo and air pumps must be worked by steam, it is claimed that the same result, viz., the smelting of 2,000 pounds of iron or steel, can be effected by the consumption of from 720 to 800 pounds of steam coal—an economy of 50 per cent. in the use of fuel. This economy is still greater, if, instead of the foregoing comparison with smelting in a Siemens regenerator, we consider the treatment of steel in crucibles, where 1,200 pounds of the best coal is consumed for each 1,000 pounds of steel, and this proportion is increased to 1,500 or even 1,600 pounds when the coal used is of inferior quality and yields a large percentage of ash. It is, therefore, confidently asserted by experts who have examined this new electrical (vacuum) smelting process that it will secure a saving of more than half the fuel that is now required for the fusion of steel in crucibles, and that the saving would be proportionately greater under conditions which would enable the current to be generated by water power.

While the preliminary experiments—which have been conducted with a current of 18 to 20 h. p.—have been brilliantly successful, with resulting products of high and uniform quality, the practical application of this new process on an industrial scale has yet to be made. Works have been built at Copenhagen, where it will soon be put into practical operation, and a syndicate has been organized for a similar purpose in southern France. The first use of the system will be in the production of small castings of iron and steel, in which high quality, smoothness of surface and freedom from flaws and air holes are especially important. In the earlier experiments, four-bladed propellers of a size suitable for electrical or steam launches were cast with such excellent results that the ultimate success of the process for fine castings up to a certain size would seem to be assured.

In the production of pig iron and other metals direct from the ores, greater difficulties will no doubt be encountered, for the reasons, among others, that the charge to be smelted will be necessarily small, and the furnace must be so constructed as to provide for the elimination of the scoriae. The experiments in this direction have been made thus far on only a small scale, but the produced iron, owing to the absence of coal or coke and the prompt withdrawal of the air and gases generated by smelting, is very pure; and since it contains a much lower percentage of carbon (2.99 per cent.) than ordinary iron, it would seem to be well adapted to the manufacture of steel.

It is estimated that with a plant equipped with a motive force of 500 to 600 h. p. and supplied with good, ordinary 48 per cent. ore, the cost of producing a ton of pig iron—allowing $2.40 per ton as the price of the ore—would not exceed $9.65, and this, in the opinion of the inventor, could be easily reduced to $8 per ton if a motive power of 1,000 h. p. were employed. In a report on this process, which has been published in "L'Electricite," a leading electrical journal of France, the statement is made that—

> The uniform distribution of the heat by the electric current through the mass to be melted adds to the advantages of the process that of perfect equality in the product, and, in fact, everything leads to the belief that the application of this system will afford a vast field for remunerative working. The cost of a new installation of this kind on a large scale would very slightly exceed that of an ordinary installation of the same importance. In reality, it would cost less, as the new system would be free from the expense of furnace repairs and replacement of crucibles, which is so large an item under the old one. In both systems the manual labor is about the same. In the new one it is, perhaps, rather less, as the work of charging the furnace is done away with, and the direct method of casting from the apparatus is more simple and economical, in addition to the fact that much less fuel is employed.

Putting aside, therefore, all mere conjectures and theorizing, and adhering strictly to what has been thus far accomplished, the record of actual results would seem to be:

(1) It has been shown that by this process a degree of heat sufficient to smelt a ton or more of iron within 15 minutes may be generated, sustained and applied at will without the use of carbon electrodes and without excessive heating or injury to other portions of the circuit. This, alone, is a fact of dominant and far-reaching importance.

(2) Castings of iron and steel, up to a weight of 200 pounds or more, have been made, which have shown all the desirable qualities—smoothness of surface, fineness of texture and freedom from much of the impurities which are always more or less incident to smelting by ordinary methods.

(3) Pig iron of excellent quality has been produced in small quantities by direct smelting from Swedish ores. The tests of this iron, as made by the Royal School of Mines at Berlin, have been published in several technical journals. These tables are too abstruse and complicated to be of general interest, but the net results may be summarized in the statement that the tractile strength of a round rod 10 millimetres in diameter was 3,410 pounds, and the resistance to compression of a rod 301 millimetres in length and 30 millitres in diameter was 57,850 kilograms, or 127,270 pounds.

The Hatchet Planimeter.

In our issue of April 14, page 491, we described briefly a simple form of planimeter for measuring the areas of curves, such as indicator diagrams. The London "Electrician," June 1, reprints from another journal a simple exposition of the geometry of this little instrument, to which those of our readers who are interested are referred. It appears that it is the invention of Mr. H. Corn Kundsen, of Copenhagen. From this brief theory of the instrument it does not appear that it is essential to start at the centre of mass of the figure. For indicator diagrams it seems to be best to place the instrument on a line through the middle of the diagram and perpendicular to the atmospheric line. It is stated that it is preferable to trace the diagrams in the directions in which they are drawn by the indicator; 8 inches is suggested as a suitable length. The starting position of the instrument need not be exactly perpendicular to the atmospheric line. Some engineers who have used the instrument say it is very suitable and very accurate for indicator diagrams.

Water an Insulator.

Prof. Kohlrausch, who has made experiments with the purest water which can possibly be produced, finds that a column of one inch has a resistance equal to a copper wire of the same cross-section passing twenty-five thousand times around the earth.

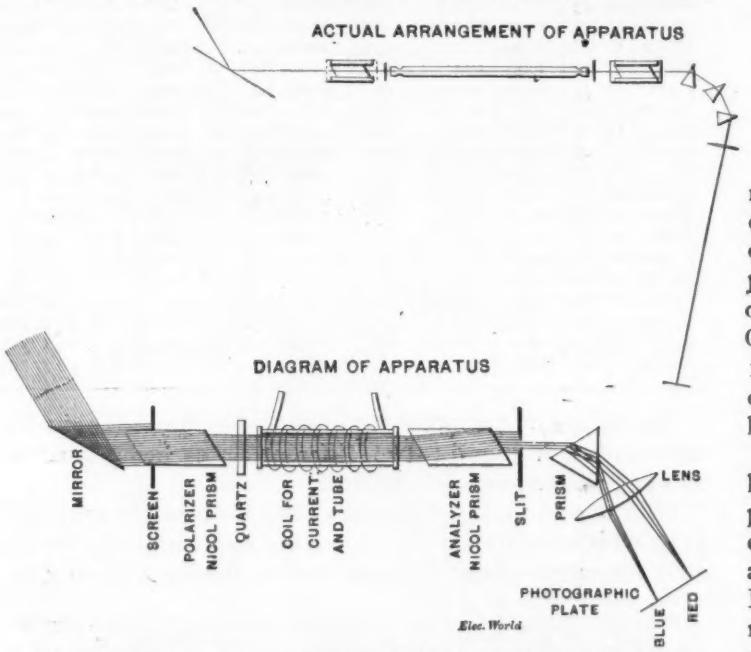
A Reliable Method of Recording Variable Current Curves.*

BY A. C. CREHORE.

The apparatus described in the paper is for the purpose of obtaining a continuous record of an alternating current flowing in a conductor, which record will not also include the effects of inertia on the parts of the apparatus. This is accomplished by a photographic record made by a beam of light influenced directly by the electric current without the intervention of any moving material.

Faraday discovered that if a beam of polarized light is passed through some substance in the direction of the lines of magnetization within that substance, there is a rotation of the plane of polarization in a direction which is the same as the direction of the current required to produce such a field.

The arrangement of the apparatus, by means of which this principle is applied, is made plain by the accompanying illustration. The quartz prism is added that small currents may be recorded, the resultant polarization being then the sum of the magnetic and quartz polarizations; without this prism the record would become faint when the current approaches zero, but since quartz also naturally rotates a beam of polarized light this difficulty is thus obviated. The tube upon which the coil carrying the current is wound is a glass tube of 1.4 centimetres internal and 1.8 centimetres external diameter, and 70.15 centimetres long. The tube is filled with carbon bisulphide, which is confined by means of two plane parallel plates of glass, each 1.3 centimetres thick,



APPARATUS FOR RECORDING VARIABLE CURRENT CURVES.

fitted tightly upon the ground ends of the tube. Upon this tube are wound six layers of No. 18 double cotton copper magnet wire, occupying a length upon the tube of 61.5 centimetres. The wire was wound so that 100 turns occupied 12.7 centimetres, thus giving 2,900 turns in all, is very large considering the size of wire. The light used was sunlight reflected from the mirror of a heliostat.

The ordinates of the record are not directly proportional to the magnetizing force, though nearly so; the displacements of the beam of light due to the current will be actually proportional to the ordinates of a parabola, but in this case the portion that applies will be so nearly a straight line that the displacement will be nearly proportional to the current.

The objections which most naturally suggest themselves against this method of taking current curves are perhaps the following: The photographic plate must move so quickly that the time of exposure of any part of the plate is extremely short. To meet this demand the most sensitive plates that can be made should be used. The width of the band with any given plate depends largely upon the time of exposure. Then, too, a plate is to be desired that will photograph toward the red end of the spectrum as well as in the blue. The band does not possess very sharp outlines, but gradually shades off from dark to light.

These objections do not have so much weight, however, in cases where the general direction of the variation of the current is what is wanted more than any exact measurement of its amount, and in the majority of cases this is really what is wanted.

Another objection of a different nature that seems difficult to avoid is the fact that the coil, which is wound upon the tube, must necessarily possess a small amount of self-induction. It may be said, however, that even though we are prohibited from measuring certain currents on account of this self-induction, we are always sure that we are measuring the exact current which is flowing through the coil.

* Abstract of a paper read at the Philadelphia meeting of the American Institute of Electrical Engineers.

Relative Cost of Alternating and Continuous Current Machines.

According to a recent statement of Prof. Forbes an alternating current dynamo can be obtained about 40 per cent. cheaper than a direct current machine for the same capacity when dealing with large powers.

Practical Notes on Dynamo Calculation.—VII.

BY ALFRED E. WIENER.

b.—Energy Dissipated by Hysteresis.

The iron of the armature core is subjected to successive magnetizations and demagnetizations. Owing to the molecular friction in the iron, a lag, in phase, is caused of the effected magnetization behind the magnetizing force that produces it, and energy is dissipated during every reversal of the magnetization. The name of "*Hysteresis*" (from the Greek ὑστερέω, to lag behind) was given by Ewing, in 1881, to this property of paramagnetic materials, by virtue of which the magnetizing and demagnetizing effects lag behind the causes that produce them.

Although Warburg,[1] Ewing,[2] Hopkinson[3] and others have made numerous researches about the nature of this property of paramagnetic substances, it was not until recently that a definite Law of Hysteresis was established. In an elaborate paper presented to the American Institute of Electrical Engineers, on Jan. 19, 1892, Charles Proteus Steinmetz[4] gave the results of his experiments, showing that the energy dissipated by hysteresis is proportional to the 1.6th power of the magnetic density, directly proportional to the number of magnetic reversals and directly proportional to the mass of the iron. This law he expressed by the empirical formula:

$$H_1 = \eta_1 \times B^{1.6} \times N_1 \times M_1 ,$$

where H_1 = energy consumed by hysteresis, in ergs;
η_1 = constant depending upon magnetic hardness of material ("Hysteretic Resistance");
B = density of lines per cm² of iron;
N_1 = frequency, or number of complete cycles of 2 reversals, per second;
M_1 = mass of iron, in cm³.

The values of the hysteretic resistance found by Steinmetz for various kinds of iron are given in the following table:

[1] Warburg, Wiedem. Ann., XIII., page 141 (1881); Warburg & Hoenig, Wiedem. Ann., XX., page 814 (1884).
[2] Ewing, Proceed. Royal Soc. XXXIV., page 39 (1882); Philos. Trans., Part II., page 526 (1885).
[3] J. Hopkinson, Philos. Trans. Royal Soc., Part II., page 455 (1885).
[4] Steinmetz, Trans., A. I. E. E., volume IX., page 3; The Electrical World, XIX., pages 73, 89 (1892); XX., page 285 (1892.)

TABLE XXIII.—HYSTERETIC RESISTANCE FOR VARIOUS KINDS OF IRON.

Kind of Iron.	Hysteretic Resistance. η_1
Sheet Iron, magnetized lengthwise	·0025 to ·005
" " ·0165" thick	·0035
" " ·015" "	·004
" " ·006" "	·005
" " magnetized across Lamination	·007
Iron Wire, length-magnetization	·0035
" " cross- "	·040
Wrought Iron, Norway Iron	·0023
" " ordinary, mean	·0033
Cast Iron, ordinary, mean	·013
" " containing ⅛% Aluminium	·0137
" " " ½% "	·0146
Mitis Metal	·0043
Tool-Steel, glass hard	·070
" " oil hardened	·027
" " annealed	·0165
Cast Steel, hardened	·012 to ·028
" " annealed	·003 " ·009

For the materials employed in building up the armature core, according to this table, we can take the following average values of the hysteretic resistance:

Sheet iron : $\eta_1 = .0035$,

Iron wire : $\eta_1 = .040$.

Inserting these values in Steinmetz's equation, and reducing the latter to our practical units, we obtain for the energy loss by hysteresis in any armature having core built of discs or ribbon:

$$w_h = 10^{-7} \times .0035 \times \left(\frac{\mathfrak{B}_a}{6.45}\right)^{1.6} \times N_1 \times 28{,}317 \times M$$
$$= 5 \times 10^{-7} \times \mathfrak{B}_a^{1.6} \times N_1 \times M, \quad (36)$$

and in any armature with core of iron wire:

$$w_h = 5.7 \times 10^{-6} \times \mathfrak{B}_a^{1.6} \times N_1 \times M, \quad (37)$$

where w_h = energy absorbed by hysteresis, in watts;
1 watt = 10^7 ergs;

$\mathfrak{B}_a$ = density of lines in armature body, per square inch of core section;

N_1 = frequency, in cycles per second, $= \frac{N}{60} \times P$;
N = number of revs. per min., P = number of pairs of poles;

M = mass of iron in armature core, in cubic feet;
1 cu. ft. = 28,317 cm³.

The mass, in cubic feet, for both drum and ring armatures is

$$M = \frac{d_a''' \times \pi \times l_a \times b_a \times k_1}{1728}; \quad (38)$$

d_a''' = mean diameter of armature core, in inches;
l_a = length of armature core, in inches;
b_a = radial depth of armature core, in inches;
k_1 = ratio of net iron section to total cross section, see Table XVIII., Chap. 12;
1728 = multiplier to convert cubic feet into cubic inches.

Formulae (36) and (37) can be rendered more convenient for practical use by uniting the terms $5 \times 10^{-7} \times \mathfrak{B}_a^{1.6}$, and $5.7 \times 10^{-6} \times \mathfrak{B}_a^{1.6}$, respectively, into one factor, η, the *factor of hysteresis*, that is the energy absorbed by hysteresis in one cubic foot of iron, when subjected to magnetization and demagnetization at the rate of one complete cycle (two reversals) per second.

For convenience, the author, in Table XXIV., has calculated the numerical values of these hysteresis factors, η, for all core densities from 10,000 to 125,000 lines per square inch, thus simplifying the equation for the hysteresis loss into the formula:

$$w_h = \eta \times N_1 \times M. \quad (39)$$

In Table XXIV., columns headed $\eta \div 480$ are added for the case the hysteresis loss is to be calculated for an armature, of which the weight, in pounds, of the iron core is known.

TABLE XXIV.—HYSTERESIS FACTORS FOR DIFFERENT CORE DENSITIES.

Magnetic Density in Armature Core. Lines of Force per sq. in.	Watts dissipated at a frequency of one complete magnetic cycle per second. Sheet iron. p. cu. ft. η	Sheet iron. per lb. $\eta \div 480$	Iron wire. p. cu. ft. η	Iron wire. per lb. $\eta \div 480$	Magnetic density in Armature Core. Lines of Force per sq. in.	Watts dissipated at a frequency of one complete magnetic cycle per second. Sheet iron. p. cu. ft. η	Sheet iron. per lb. $\eta \div 480$	Iron wire. p. cu. ft. η	Iron wire. per lb. $\eta \div 480$
10000	1·25	·0026	14·3	·030	66000	25·72	·0537	294·0	·613
15000	2·40	·0050	27·4	·057	67000	26·34	·0550	301·0	·628
20000	3·79	·0079	43·3	·090	68000	26·97	·0563	308·2	·643
25000	5·42	·0113	62·0	·129	69000	27·61	·0576	315·5	·658
30000	7·30	·0152	83·5	·174	70000	28·26	·0589	322·8	·673
31000	7·70	·0160	88·0	·183	71000	28·91	·0603	330·1	·688
32000	8·10	·0168	92·6	·192	72000	29·56	·0617	337·6	·704
33000	8·50	·0177	97·2	·202	73000	30·22	·0631	345·1	·720
34000	8·91	·0186	101·8	·212	74000	30·89	·0645	352·9	·736
35000	9·33	·0195	106·5	·222	75000	31·56	·0659	360·7	·752
36000	9·76	·0204	111·5	·232	76000	32·23	·0673	368·5	·768
37000	10·20	·0213	116·5	·242	77000	32·91	·0687	376·3	·784
38000	10·65	·0222	121·6	·253	78000	33·60	·0701	384·2	·800
39000	11·10	·0231	126·8	·264	79000	34·29	·0715	392·1	·817
40000	11·55	·0240	132·0	·275	80000	34·99	·0730	400·0	·834
41000	12·01	·0250	137·2	·286	81000	35·69	·0745	408·0	·851
42000	12·48	·0260	142·5	·297	82000	36·40	·0760	416·0	·868
43000	12·96	·0270	148·0	·308	83000	37·11	·0775	424·0	·885
44000	13·45	·0280	153·7	·320	84000	37·82	·0790	432·4	·902
45000	13·95	·0290	159·4	·332	85000	38·54	·0805	440·8	·919
46000	14·45	·0300	165·1	·344	86000	39·27	·0820	449·2	·936
47000	14·95	·0311	170·8	·356	87000	40·01	·0835	457·6	·954
48000	15·45	·0322	176·6	·368	88000	40·75	·0850	466·0	·972
49000	15·96	·0333	182·4	·380	89000	41·50	·0865	474·5	·990
50000	16·48	·0344	188·3	·392	90000	42·25	·0881	483·0	1·008
51000	17·01	·0355	194·3	·405	91000	43·00	·0897	491·5	1·023
52000	17·55	·0366	200·6	·418	92000	43·76	·0913	500·0	1·042
53000	18·10	·0377	206·9	·431	93000	44·53	·0929	509·0	1·064
54000	18·65	·0388	213·2	·444	94000	45·30	·0945	518·0	1·080
55000	19·21	·0400	219·5	·457	95000	46·07	·0961	527·0	1·098
56000	19·78	·0412	226·0	·470	96000	46·85	·0977	536·0	1·116
57000	20·35	·0424	232·6	·484	97000	47·63	·0993	545·0	1·135
58000	20·92	·0436	239·2	·498	98000	48·41	·1009	554·0	1·154
59000	21·50	·0448	245·8	·512	99000	49·20	·1025	563·0	1·173
60000	22·09	·0460	252·5	·526	100000	50·00	·1041	572·0	1·192
61000	22·69	·0472	259·4	·530	105000	54·06	·1127	618·0	1·290
62000	23·29	·0485	266·3	·554	110000	58·23	·1215	666·0	1·388
63000	23·89	·0498	273·0	·568	115000	62·53	·1305	715·0	1·490
64000	24·50	·0511	280·0	·583	120000	66·95	·1400	765·0	1·595
65000	25·11	·0524	287·0	·598	125000	71·50	·1500	817·5	1·705

The values of η contained in this table are graphically represented in Fig. 14, two different scales being used in plotting the curves, as designated.

With regard to the exponent of $\mathfrak{B}_a$, in formulæ (36) and (37), which Steinmetz found to be approximately = 1.6 over the whole range of magnetization, Ewing,[1] by very recent investigations has found that it varies at different mag-

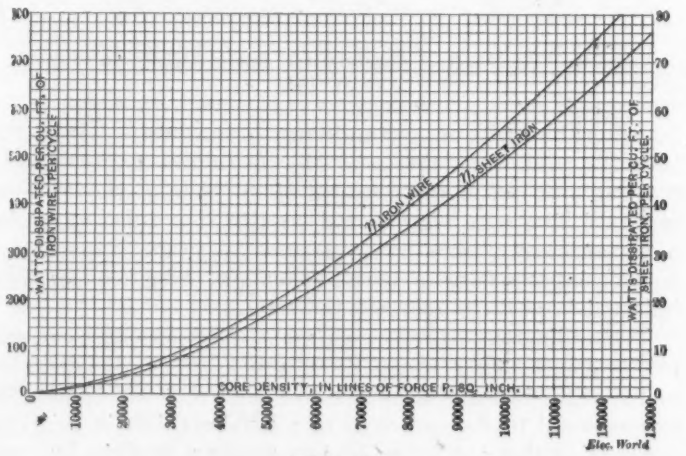

WATTS DISSIPATED PER CU. FT. OF IRON WIRE, 1 PER CYCLE
WATTS DISSIPATED PER CU. FT. OF SHEET IRON, 1 PER CYCLE
IRON WIRE
SHEET IRON
CORE DENSITY, IN LINES OF FORCE P. SQ. INCH.
Elec. World

FIG. 14.

[1] J. A. Ewing and Miss Helen G. Klaassen, Philos. Trans. Roy. Soc.; "Electrician" (London), volume XXXII., pages 636, 668, 713; XXXIII., pages 6, 38 (April and May, 1894); The Electrical World, XXIII., pages 569, 573, 614, 680, 714, 740 (April and May, 1894); "Electrical Engineer," XVII., page 417 (May 9, 1894).

netizations. In the case of thin sheet iron (.0185 inch), for instance, the hysteretic exponent ranged as follows:

TABLE XXV.—HYSTERETIC EXPONENTS FOR VARIOUS MAGNETIZATIONS.

Magnetization.		Hysteretic Exponent.
In Lines per c. m.² (Gausses).	In Lines of Force per sq. inch.	
200 to 500	1,300 to 3,000	1·9
500 " 1,000	3,000 " 6,500	1.68
1,000 " 2,000	6,500 " 13,000	1.55
2,000 " 8,000	13,000 " 50,000	1.475
8,000 " 14,000	50,000 " 90,000	1.7

Although Ewing thus has shown that no formula with a constant exponent can represent the hysteretic losses within anything like the limits of experimental accuracy, he concludes that Steinmetz's exponent 1.6 gives values which are nowhere so grossly divergent from the truth as to unfit them for use in practical calculations. This conclusion holds particularly good for the densities applied in dynamo-electric machinery, as from the table given above can be seen that for densities between 4 and 14 kilogausses (25,000 and 90,000 lines per square inch, respectively), see Table XVII., chapter 12, the hysteretic exponent, according to Ewing's experiments, varies from 1.475 to 1.7, the average of which is 1.59, indeed a good agreement with Steinmetz's value.

Experiments on the variation of the hysteretic loss per cycle as function of the temperature have been made by Dr. W. Kunz,[1] for the temperatures up to 800 degrees C. They

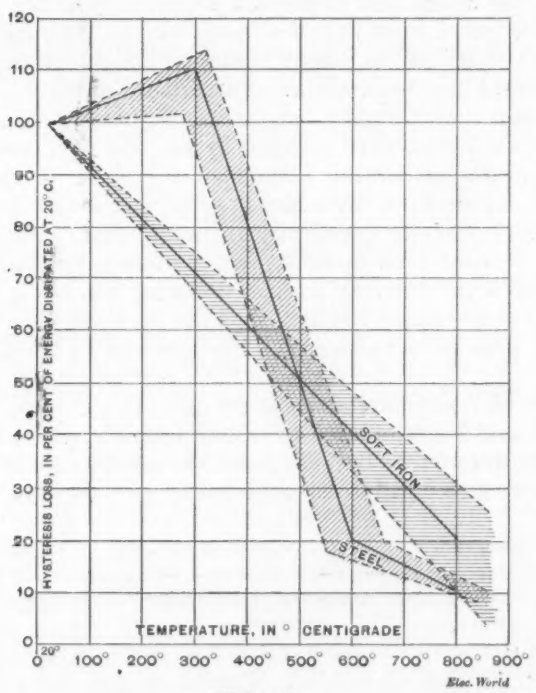


FIG. 15.

show that with rising temperature the hysteresis loss decreases according to a law expressed by the formula

$$H = a + b\,t,$$

where H = hysteresis loss per cycle, in ergs;
t = temperature, in centigrade degrees.
a and b = constants for the material, depending upon the temperature and on the maximal induction.

The decrease of the hysteretic loss, consequently, consists of two parts: one part, $b\,t$, which is proportional to the increase of the temperature, and another part, a, which becomes permanent, and seems to be due to a permanent change of the molecular structure, produced by heating. This latter part, in soft iron, is also proportional to the temperature, thus making the hysteretic loss of soft iron a linear function of the temperature, but is irregular in steel.

The curves in the latter case show a slightly ascending line to about 300 degrees C., then change into a rapidly descending straight portion to about 600 degrees C., when a second "knee" occurs, and the descension becomes more gradual.

The writer has refigured all of Kunz's test results, basing the same upon the hysteresis loss at 20 degrees C. as unity in every set of observations. In Fig. 15 dotted lines have then been drawn, enclosing all the values thus obtained, for soft iron and for steel, respectively, and two full lines, one for each quality of iron, are placed centrally in the planes bounded by the two sets of dotted lines, thus indicating the average values of the hysteretic losses, in per cent. of the energy loss at 20 degrees C. Arranging the same in form of a table, the following law is obtained:

TABLE XXVI.—VARIATION OF HYSTERESIS LOSS WITH TEMPERATURE.

Temperature in Centigrade Degrees.	Energy dissipated by Hysteresis in per cent. of Hysteresis Loss at 20° C.	
	Soft Iron.	Steel.
20°	100	100
100°	90	103
200°	80	106
300°	70	110
400°	60	80
500°	50	50
600°	40	20
700°	30	15
800°	20	10
20°	70	40

The last row of this table, which gives the hysteresis loss at 20 degrees C., at the end of the test, shows that the energy required to overcome the hysteretic resistance is reduced to about 70 per cent. in case of soft iron and to about 40 per cent. in case of steel, after having been subjected to magnetic cycles at high temperatures. Kunz further found that the hysteretic energy loss can thus be considerably reduced by repeatedly applying high temperatures while iron is under cyclic influence.

For soft iron a set of straight lines was obtained in this way, each following of which had a lower starting point, and descended less rapidly than the foregoing one, until, finally, after the fourth repetition of the heating process, a stationary condition was reached.

For steel, already the second set of tests with the same sample did not show the characteristic form of the, at first ascending, then rapidly, and finally slowly descending steel curve, but furnished a rapidly descending straight line. For every further repetition, the corresponding line becomes less inclined, and for the fifth test is parallel to the axis of abscissae. Steel, therefore, after heating it but once as high as 800 degrees C., loses its characteristic properties, and with every further repetition becomes a softer, less carbonaceous iron.

c.—Energy Dissipated by Eddy Currents.

From his experiments Steinmetz also derived that the energy consumed in setting up induced currents in a body of iron increases with the square of the magnetic density, with the square of the frequency, and in direct proportion with the mass of the iron:

$$H_2 = \varepsilon_1 \times B^2 \times N_1 \times M_1;$$

H_2 = energy dissipated by eddy currents, in ergs;
B = density of lines of force, per cm² of iron;
N_1 = frequency, in cycles per second, = $\frac{N}{60} \times P$;
M_1 = mass of iron, in cm³;

[1] Dr. W. Kunz, "Elektrotechn. Zeitschr.," volume XV., page 194 (April 5, 1894); The Electrical World, XXIII., page 647 (May 12, 1894).

ε_1 = constant, depending upon the thickness and the specific electric conductivity of the material:

$$\varepsilon_1 = \frac{\pi^2}{6} \times \delta_1^2 \times \gamma_1 \times 10^{-9} = 1.645 \times \delta_1^2 \times \gamma_1 \times 10^{-9}.$$

δ_1 = thickness in cm;
γ_1 = specific conductivity in mhos;
for iron: γ_1 = 100,000 mhos;
for copper, γ_1 = 700,000 mhos.

Inserting the value of ε_1, with reference to iron, into the

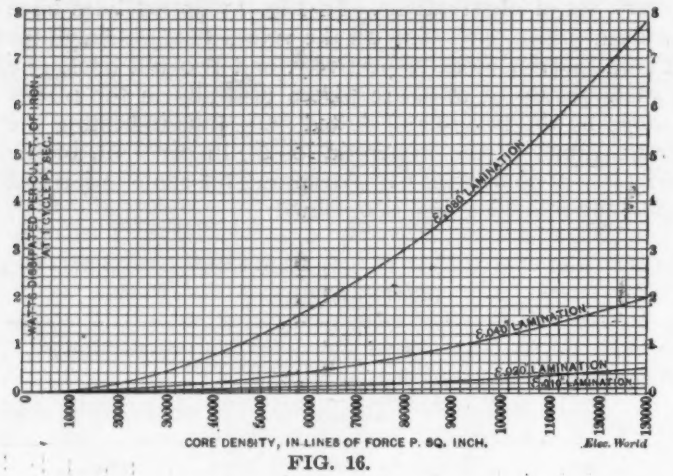

WATTS DISSIPATED PER CU. FT. OF IRON AT 1 CYCLE PER SEC.
.010" LAMINATION
.020" LAMINATION
.040" LAMINATION
.080" LAMINATION
CORE DENSITY, IN LINES OF FORCE P. SQ. INCH.
Elec. World

FIG. 16.

above formula, and transforming into practical units, the eddy current loss in an armature, in watts, is obtained:

$$w_e = 10^{-7} \times 1.645 \times (2.54\ \delta)^2 \times 10^{-4} \times \left(\frac{\mathfrak{B}_a}{6.45}\right)^2 \times N_1^2 \times 28{,}317 \times M\pi = 7.22 \times 10^{-8} \times \delta^2 \times \mathfrak{B}^2_a \times N_1^2 \times M. \quad (40)$$

δ = thickness of lamination, in inches;
$\mathfrak{B}_a$ = core-density, in lines of force, per square inch;
N_1 = frequency, in cycles per second;
M = mass of iron, in cubic feet.

Uniting again $7.22 \times 10^{-8} \times \delta^2 \times \mathfrak{B}^2_a$ into one factor, in this case the *Eddy Current Factor*, ε, we have the simplified formula:

$$w_e = \varepsilon_1 \times N_1^2 \times M. \quad (41)$$

The values of ε for core-densities from 10,000 to 125,000 lines per square inch and for laminations of thickness, δ = .010", .020", .040" and .080", are given in Table XXVII.

Curves corresponding to the values of ε in the above table are plotted in Fig. 16.

(To be continued.)

TABLE XXVII.—EDDY CURRENT FACTORS FOR DIFFERENT CORE DENSITIES AND FOR VARIOUS LAMINATIONS.

Magnetic Density in Armature Core. Lines of Force per sq. in.	Watts dissipated per cubic foot of iron at a frequency of 1 cycle per second. Thickness of Lamination, δ				Magnetic Density in Armature Core. Lines of Force per sq. in.	Watts dissipated per cubic foot of iron at a frequency of 1 cycle per second. Thickness of Lamination, δ			
	.010"	.020"	.040"	.080"		.010"	.020"	.040"	.080"
10000	.0007	.003	.012	.046	66000	.0315	.126	.503	2.013
15000	.0016	.007	.026	.104	67000	.0325	.130	.519	2.075
20000	.0029	.012	.046	.185	68000	.0335	.134	.534	2.137
25000	.0045	.018	.072	.288	69000	.0345	.138	.550	2.200
30000	.0065	.026	.104	.416	70000	.0355	.142	.566	2.265
31000	.0070	.028	.111	.444	71000	.0365	.146	.582	2.330
32000	.0074	.030	.118	.472	72000	.0375	.150	.599	2.396
33000	.0079	.032	.126	.503	73000	.0385	.154	.616	2.463
34000	.0084	.034	.134	.534	74000	.0396	.158	.633	2.530
35000	.0089	.036	.142	.567	75000	.0407	.163	.650	2.600
36000	.0094	.038	.150	.600	76000	.0418	.167	.668	2.670
37000	.0099	.040	.158	.633	77000	.0429	.171	.685	2.740
38000	.0104	.042	.167	.667	78000	.0440	.176	.703	2.810
39000	.0110	.044	.176	.703	79000	.0451	.180	.721	2.883
40000	.0116	.046	.185	.740	80000	.0462	.185	.740	2.958
41000	.0122	.049	.194	.777	81000	.0474	.190	.758	3.033
42000	.0128	.051	.204	.815	82000	.0486	.194	.777	3.108
43000	.0134	.054	.214	.855	83000	.0498	.199	.796	3.184
44000	.0140	.056	.224	.896	84000	.0510	.204	.815	3.260
45000	.0146	.059	.234	.937	85000	.0523	.209	.835	3.340
46000	.0153	.061	.245	.979	86000	.0535	.214	.855	3.420
47000	.0160	.064	.256	1.022	87000	.0548	.219	.875	3.500
48000	.0167	.067	.267	1.066	88000	.0560	.224	.895	3.580
49000	.0174	.070	.278	1.110	89000	.0573	.229	.916	3.662
50000	.0181	.072	.289	1.155	90000	.0586	.234	.937	3.745
51000	.0188	.075	.300	1.200	91000	.0599	.240	.958	3.830
52000	.0195	.078	.312	1.248	92000	.0612	.245	.979	3.915
53000	.0202	.081	.324	1.297	93000	.0625	.250	1.000	4.000
54000	.0210	.084	.337	1.346	94000	.0638	.255	1.021	4.085
55000	.0218	.087	.349	1.397	95000	.0651	.261	1.043	4.170
56000	.0226	.091	.362	1.448	96000	.0665	.266	1.064	4.257
57000	.0234	.094	.375	1.500	97000	.0679	.272	1.086	4.345
58000	.0242	.097	.389	1.555	98000	.0693	.277	1.109	4.436
59000	.0251	.101	.403	1.610	99000	.0707	.283	1.132	4.528
60000	.0260	.104	.416	1.665	100000	.0722	.289	1.156	4.622
61000	.0269	.108	.430	1.720	105000	.0797	.319	1.274	5.095
62000	.0278	.111	.444	1.776	110000	.0875	.350	1.398	5.593
63000	.0287	.115	.458	1.833	115000	.0955	.382	1.528	6.113
64000	.0296	.118	.473	1.891	120000	.1040	.416	1.664	6.655
65000	.0305	.122	.486	1.951	125000	.1128	.451	1.806	7.222

Woven Wire Brushes.

To the Editor of The Electrical World :

I greatly dislike making claims for priority, and I do so in the present case merely in the interests of the public.

I observe that it is being claimed that certain "broad fundamental" U. S. A. patents, dated 1889 and 1891, control "all forms of woven wire dynamo brushes," or, as we call them in England, wire gauze brushes. Permit me, therefore, to announce to all whom it may concern, that in the British patent 12,372 of Oct. 16, 1885, in the names of L. S. Crossley, W. T. Godden and myself, for "Improved means for regulating the action of dynamo-electric machines," the following passage occurs: "The brush or rubber may be composed of fine wire gauze rolled into a flat mass of the requisite thickness, and to prevent the fraying of the edges, we cut the gauze from the sheet diagonally." The late L. I. Crossley's share of the patent relates to the governing of a shunt wound dynamo running at a variable speed and occasionally in reverse directions, as in train lighting. The other details of the patent were invented by me, and Mr. Godden's name appeared as senior partner of my firm. I did not recognize, at the time, the importance of wire gauze brushes, though they worked excellently from the first. This was, perhaps, because even in 1885 my dynamos were practically sparkless. Unfortunately for me, no claim was made in the patent for wire gauze brushes, and the invention is and always has been public property. For this reason I write this letter.

A somewhat similar claim was set up in this country some time ago, and I was obliged to stop it privately, as I was unable to do so publicly, because professional etiquette in England strictly forbids all direct advertising by consulting engineers.

London, England. ALEXANDER P. TROTTER.

The Antwerp Exhibition.

One of the features of interest in the Antwerp Exhibition will be a number of exhibits illustrating the history and progress of the various forms of artificial illumination. All kinds of lights, from the early Pompeiian and Roman lamps down to the most modern forms of electric lamp, will be represented. To electrical engineers a complete series of exhibits of this character would be both an interesting and instructive sight, and it is to be hoped that every effort will be made to make it as complete as possible.

Underground Electric Railway for Paris.

Work will soon be begun on the underground electric railway from the Bois de Boulogne to the Porte de Vincennes, which will have a length of 11.2 kilometres and the tunnel a diameter of 6.3 metres. The speed of trains will be 20 kilometres per hour, and the voltage of the electric current 500.

THE ELECTRICAL WORLD'S DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING.

ELEC. WORLD, N.Y.

ELECTRO-PHYSICS.

The Work of Hertz.—The first part of a Royal Institute lecture by Prof. Lodge is published in the Lond. "Elec.," June 8. A portrait of Hertz and a complete list of eighteen of his papers, which are not incorporated in his book, are given. In the lecture he gives experimental demonstrations of the outcome of Hertz's work; the present portion is somewhat elementary, starting with analogies of electrical and other waves, and a brief description of the vibrator. The lecture is discussed in the leading editorial, where the apparatus as made by Dr. Lodge is briefly described; the oscillating sphere and the sparking apparatus are enclosed in a wooden box, the waves set up being allowed to escape only in one direction through a circular aperture in front, thus forming a sort of electrical lantern, which was here exhibited for the first time; the present apparatus is said to simplify greatly the demonstration of Hertz's researches.

Flow of Electricity from Points.—An article by Mr. Precht from the "Ann. Phys. u. Chem.," volume XLIX., page 150, on the absolute measurement of the flow, is abstracted in the "Foreign Abstracts of the Inst. of Civ. Eng.," volume CXV., Part I.; the voltage at which flow began was quite different for the positive than for the negative conductor and differed also very greatly with the materials and their conditions; among other things he found that there was less discharge from a bundle of points than from a single one; to produce a charge of 100×10^{-9} amperes, from one particular needle, an average voltage of 8,188 was required; in the paper some calculations are given of the quantity dispersed silently by an ordinary lightning conductor during a storm.

Electric Waves.—A correspondence of Mr. Deeley is published in the Lond. "Elec.," June 8, and is discussed editorially; the question involved refers as to whether electric and magnetic fields can exist independently.

Electro-Magnetic Properties of Parallel Conductors.—The article by Mr. Steinmetz, mentioned in the Digest last year, is abstracted in the "Foreign Abstracts of the Inst. of Civ. Eng.," volume CXV., Part I.

Electricity and Its Connection with Other Physical Phenomena.—An article by Mr. Schwartze on this subject is published in the "Elek. Anz.," May 31.

Electricity from Waterfalls.—A note in "Cosmos," June 9, refers to experiments of Mr. Lenard made with waterfalls in the Alps, showing that the water is charged positively and the air surrounding it negatively.

MAGNETISM.

Intense Magnetic Fields.—A translation of the article of Prof. Du Bois, mentioned in the Digest April 7, May 5 and May 19, is published in abstract in the "Phil. Mag." for June. A large ring was used, made of the best Swedish iron, 50 centimetres mean diameter and 10 centimetres thick; a magnetomotive force of 108,000 ampere turns could be used; the highest value of the inductance was about 180 henrys, corresponding to a time ratio of 75 seconds. He found that the absolute leakage diminished considerably as the current was increased, and that it was therefore a fallacy to assume that leakage must always increase when saturation is being approached; the leakage was also considerably diminished by the ampere turns near the air gap, which fulfilled the function of keeping the flux from spreading; the strong fields were produced by concentrating the flux through properly shaped pole pieces, the shape of which was determined empirically; a truncated cone of a semi-vertical angle of 60 degrees was found best; for a diameter of the field of 5 millimetres, $\mathfrak{H}$ was equal to 36,800 C. G. S. units and for 3 millimetres, 38,000; the induction in a piece of thin iron wire was found to be 60,000, which corresponds to a tension of 144 kilograms per square centimetre. He thinks that it is possible to obtain fields of 40,000 with such magnets, but that above this it would require apparatus out of proportion with the purpose in view.

Magnetization at High Frequency.—The paper abstracted in the Digest June 16 is abstracted more fully in the "Phil. Mag." for June.

Magnetic Action of Cathode Rays.—The Lond. "Elec.," June 8, contains an article discussing Lenard's experiments, more particularly the fact that cathode rays are deflected by a magnetic force.

Alternate Current Magnets.—The article abstracted in the Digest June 2 is published in full in the "Phil. Mag." for May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Polarity Indicator.—In the "Zeit. fuer Elek.," May 15, Mr. Kratzert states that with litmus paper, curcuma paper and pole-reagent paper, the positive electric pole acts like an acid and the negative like a base (alkali); if litmus paper is moistened with acid the positive pole will color it black and the negative blue; if moistened with a base the reaction is the same as with ordinary paper.

Hummel Meter.—A translation of the description of this meter, referred to in the Digest June 9, is given, together with the illustrations, in the Lond. "Elec. Rev.," June 8.

Physical Units.—An article by Mr. Maclean is begun in the Lond. "Elec. Eng.," June 8.

DYNAMOS AND MOTORS.

Non-Synchronous Motors.—A mathematical paper on motors with short circuited armatures, by Prof. Potier, is published in the "Bul. Soc. Int." for May; fundamental formulas are deduced and their application illustrated by numerical examples. In the discussion, Mr. Boucherot gives a summary of the results, in the form of curves, of the measurements mentioned in the Digest June 23, under "Transmission of Power."

Polymorphique Generators.—The classification given in Mr. Hospitalier's article (see Digest, June 16), together with the list of installations where the various types are used, is published in the Lond. "Elec. Eng.," June 8.

Cail-Helmer Generator.—A translation of the descriptive article mentioned in the Digest, Nov. 18, 1893, is given in the "Foreign Abstracts of the Inst. of Civ. Eng.," volume CXV., Part I.

ARC AND INCANDESCENT LIGHTS.

Multiple-Filament-Lamp Base.—A base is described and illustrated in the "Elek. Anz.," June 3, in which all three filaments are connected with one end to one pole and the other ends with three metallic rings on the base, connection to which is made with three concentric milled head keys.

Investigations with the Alternating Current Arc.—An abstract of the article by Mr. Blondel, mentioned in the Digest Oct. 14 and 28, 1893, is given in the "Foreign Abstracts of the Inst. of Civ. Eng.," volume CXV., Part. I.

TRANSMISSION OF POWER.

Power Distribution by Electricity, Water and Gas.—A paper by Mr. De Segundo is reprinted in part in the Lond. "Elec. Eng.," June 8; it is devoted entirely to the mechanical engineering features of the problem.

Polyphase Transmission.—A short abstract of the article mentioned in the Digest May 19 is given in the Lond. "Elec. Eng.," June 8.

ELECTRIC RAILWAYS.

Electric Traction.—The criticisms of Mr. Lea of the views of Prof. Kennedy, abstracted in the Digest May 19, are contained more in detail in London "Engineering," April 27. Mr. Lea calls attention to the fact that no allowance was made for the dead weight of the locomotive, which does not exist in electric trains; he works out the efficiency of 69 per cent. from the indicated horse power to that exerted at the wheels; in addition, the ratio between the fuel efficiencies of stationary locomotive engines will be at least five to three, if not more, the final ratio based on coal bills being, therefore, as 34.5 to 24, which is quite different from the figures of Prof. Kennedy; in conclusion, he calls attention to the fact that no system is best for all cases, and that there is a proper place for cable lines, as also for oil and gas motors.

In a communication to the Lond. "Elec. Rev.," June 8, Mr. Sellon criticises a recent statement in that paper (see Digest, June 23), claiming that it, as well as the statement of Prof. Kennedy, are erroneous; he suggests that the working cost of the South Staffordshire, the Liverpool and the Blackpool systems will show figures which will compare favorably with any single form of traction in that or any other country. In the same issue Mr. Dickenson criticises the same statements and claims that electric lines are operated 6 cents per mile cheaper than steam tramways.

Corrosion of Pipes.—The Lond. "Elec. Rev.," June 8, in in an editorial, gives a brief synopsis of the discussion of Mr. Farnham's paper, read at the American Institute of Electrical Engineers, and claims that the term electrolysis was misapplied in this discussion, and that it was not electrolysis but electro-chemical effects on metals which was under discussion. With platinum plates it requires about 1.5 volts to decompose acidulated water, but between lead plates a much smaller voltage is required, between iron still smaller and between zinc still less, as the affinity of the metal enters into the reaction; metal pipes in moist earth are already just on the point of corrosion, so that the slightest additional force in the form of electrical voltage at once determines vigorous action, the various extraneous voltage being added to their own; electrolysis might be confined to the splitting up of compounds between electrodes which are not acted upon themselves, while in chemical action one or both electrodes enter into the action.

Mountain Railway.—The Lauterbrunnen-Muerren railway (the electrical part of which is not really a steep grade road) is described and illustrated in "Cosmos," June 2; a short abstract of the article is published in the Lond. "Elec. Eng.," June 8.

Guernsey.—An illustrated description of the railway on this island installed by Siemens Brothers, of London, is given in the "Bull. de l'Inst. Montifiore," May 31; in includes some working drawings, switchboard and car wire diagrams and a diagram of the currents during a trip.

Lyons.—An illustrated article by Mr. Birthon is begun in "L'Elec.," June 2; he discusses in general the calculation of the motive power for electric railways, the line, etc.

Newcastle.—A report for the proposed railway is published in detail in the Lond. "Elec. Eng.," June 8.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Portsmouth.—The greater part of the issue of the Lond. "Elec. Rev.," June 8, is devoted to a long and well illustrated description of the recently inaugurated plant in this city. It is of interest partially because it is the first plant in England in which the flywheel of the engine is formed of the fields of the alternator and that currents used for street arc lighting are obtained from rectified alternating currents; it is claimed that this station has departed more than any other in England from the recognized engineering practice; also that Ferranti can claim the honor of being the first to use commutated currents in actual work. The commutators, or rectifiers, are described and illustrated; there are five circuits, each for 20 arc lamps at 12 amperes; the current is commutated by a simple four-part commutator, running at 1,500 revolutions and driven by a synchronous self-starting alternating current motor; there is said to be no more sparking than with a Brush machine; the current for these circuits is supplied by a special transformer, in which the E. M. F. varies according to the load on the secondary, the current being automatically kept constant, thus forming a constant current transformer; this result is obtained by means of a movable primary coil, suspended and balanced so that it will be floated by the secondary coils, any increase in current in the latter causing repulsion and a consequent motion of the primary coil, which decreases the voltage, thus keeping the current constant. The transformers for the incandescent light circuits may be adjusted for full or half load by means of a key, which connects the two halves of the primary either in series or in parallel and the same with the two halves of the secondary; it is the intention to do this automatically. There is also a Parsons condensing steam turbine of 100 kilowatts, having a range of about 300-fold expansion and a speed of only 3,000; it is chiefly remarkable as being the largest of its type ever built. A description of this station, but without the illustrations, is given in the Lond. "Elec. Eng.," June 8. A briefer description, containing some different cuts, is given in the Lond. "Elec.," June 8.

London "Lightning" publishes an illustrated description in the form of a supplement.

Burton.—An illustrated description of this station is given in the Lond. "Elec. Eng.," June 8; a very short one is given in the Lond. "Elec."; the fuel for the electric plant consists of the refuse of the neighboring gas plant, both being under the same management.

Christiania.—A short abstract of the article mentioned in the Digest, June 28, giving a number of the figures, is published in the Lond. "Elec. Eng.," June 8.

Earning Capacity of Incandescent Lamps.—The following figures are given in the Lond. "'Electrical Industry," June 1, attention being called to the fact that they should be used cautiously, as such statistics are often misleading. In a large central station supplying an important part of the West Central district of London, the number of kilowatt hours (per annum) per 8-c. p. lamp installed is as follows: Private houses, 5 to 26; stores, 15 to 30; hotels, 30 to 60; churches, 3 to 13; theatres, 8 to 20. In another district the averages are as follows: Club houses, 44.14; hotels, 41.97;

stores, 13.78; restaurants, 27.42; churches, 6.11; hospitals, 10.46; banks, 22.55; staircases in flats and chambers, 38.

Storm Indicator.—The Lond. "Elec.," June 8, suggests editorially that a metallic microphone might be used to give warning of an electrical storm long before the storm is near enough to do any damage to the line; it is based on the statement of Prof. Lodge that the metallic microphone is so delicately constituted that it will respond to feeble electric oscillations propagated at enormously great distances from the place where it is stationed.

Laval Steam Turbine.—A very complete description by Mr. Sosnowski, with a large number of illustrations, is published in the "Bull. Soc. Int." for May.

WIRES, WIRING AND CONDUITS.

Cause of Short Circuits.—The Lond. "Elec.," June 8, in an editorial on Hertzian waves, calls attention to the fact that the surging caused by electrical disturbances in the neighborhood of wires is sufficient to give rise to a small spark between the wires, which will be followed by an arc if those wires are used for conveying currents, and it is claimed that some cases of assumed short circuits in electric light leads have been caused in this manner; it is suggested that for this reason the positive and negative leads in a building should be separated for some distance.

Couplings for Underground Wires.—The coupling mentioned in the Digest June 16 is described and illustrated in the Lond. "Elec. Rev.," June 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephony and Rapid Telegraphy.—In referring to Prof. Pupin's recent invention (see The Electrical World, May 19), the Lond. "Elec. Rev.," June 8, states that the arrangement is old, is founded on fallacies, and instead of increasing the working speed tends to do exactly the reverse; it suggests that inventors should try their inventions before patenting or publishing them.

Microphone.—A microphone made in Germany, consisting of powdered carbon between a carbon plate and a carbon diaphragm, is described and illustrated in the "Elek. Echo," June 9; one of the chief claims of novelty is the method of adjusting the rear plate; the loudness and clearness are claimed to be better than in any other microphones and the consumption of current exceedingly small, being from 0.02 to 0.005 amperes.

Telegraph and Telephone Line Construction.—An article on the recent German practice, published last year, is abstracted briefly in the "Foreign Abstracts of the Inst. of Civ. Eng.," volume CXV., Part I.

Telegraphs in Persia.—A Society of Arts paper by Mr. Wells is published in abstract in the Lond. "Elec. Rev.," June 8.

Fire Alarm System in Vienna.—The paper by Mr. Stern is concluded in the "Zeit. fuer Elek.," May 15.

Pacific Cable.—Another letter on this subject is published in the Lond. "Elec. Eng.," June 8.

ELECTRO-CHEMISTRY.

Copper Zinc Accumulator.—The history of this accumulator is given in a continued article in the "Elek. Anz.," May 20 and June 3.

Electrolysis of Fused Salts.—The Vautin process for obtaining sodium or caustic soda and chlorine is described in Lond. "Electrical Industry," June 1. (See Digest June 2 and 23.)

MISCELLANEOUS.

Electricity in Plants.—Mr. Hill in Lond. "Elec.," May 18, claims to have obtained sufficient current to ring a bell from a battery of 12 melons connected in series by platinum wires inserted at the top and bottom; the melons should be nearly ripe and should be placed on glass. He claims to have been the first to discover the fact stated in a French journal (see Digest March 31), that an electric current can be noticed between the eye and the stem, and also between other parts of fruits.

Electric Log.—A log for indicating the speed of vessels, which was recently tested, is described and illustrated in "La Nature," May 19; an electric bell is rung on the completion of a certain number of revolutions of the cup shaped wheels which are constructed.

Compass for Automatic Steering.—The device described in the Digest June 2 is described in detail, including a number of illustrations, in "La Lum. Elec.," May 26.

Suggestions for Transit Systems—III.*

BY S. D. MOTT.

I send herewith several suggestions of what may appropriately be called a gravity system of electric street traction, as, in the colloquial language of the times, gravity pushes

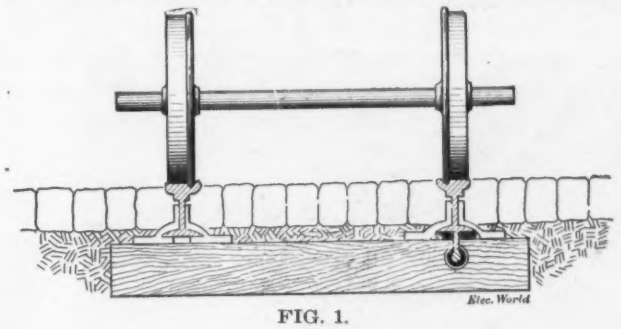


FIG. 1.

the button and the electric current, acting conjointly with the ordinary car equipment, does the rest.

Fig. 1 shows a cross-section of track arranged with positive track conductor on right, together with negative rail or ground return on left, and Fig. 2 is a horizontal elevation in part section of track arrangement. The idea involved is a depressionable rail or rails, divided into car lengths, cushioned by washers, and which are normally out of the circuit. A slight depression given by the weight of the car, say one-eighth of an inch or less, will cause the rail to make electric contact with the well-insulated sub-surface conductor, closing the circuit through the usual car equipment. At say three points of each rail length contacts are arranged from a sealed underground main, which, when brought into contact with the rail or a depressionable groove of the rail, charges it with the current, so that only the rails immediately beneath the car are energized.

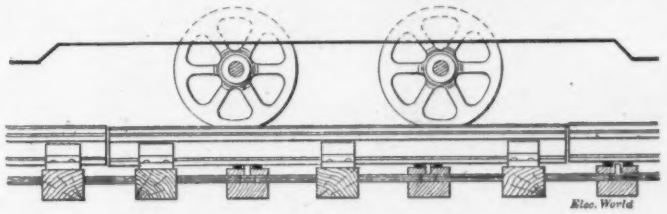


FIG. 2.

The rails may be prevented from creeping by properly

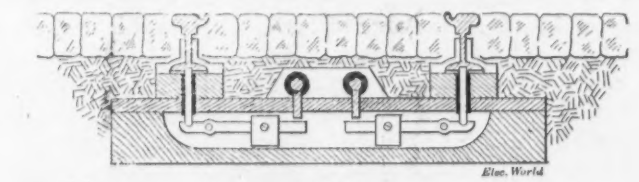


FIG. 3.

disposed spikes or other fastenings in the usual manner. When operated with an E. M. F. not to exceed 500 volts there would be no danger to man or beast, even if by any possible means the circuit could be closed through them; with around

* For parts I. and II. of this article see The Electrical World of April 28, 1894, page 576, and May 26, 1894, page 719.

200 volts E. M. F. the current in any event would not be disagreeably perceived. As with all electric street systems, except the return circuit conduit, the rails in bad weather should be kept clean by proper car accessories, such as re-

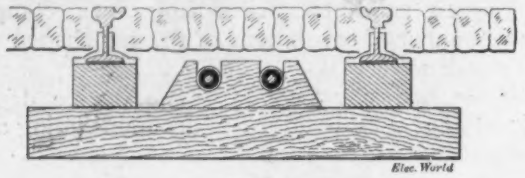


FIG. 4.

volving brushes in front of the wheels. In Figs. 1 and 2 the rails are kept in horizontal alignment by the elasticity of rubber or its equivalent. In Fig. 3 gravity is substituted for retractile devices, and the weight upon the track sufficient to depress the rail or rails to make contact with conductor is adjustable. Fig. 3 is a cross-section of track at point of making contact, and Fig. 4 is an intermediate section.

The favorable features of such a system are the cheapness of construction when compared with open underground work, requiring some sort of slot, and necessarily the expensive cable yoke to support it; unobstructed streets, freedom from complication, springs, switches, magnets, etc., conventional appearance, and ordinary rails. Any thoroughly protected underground conductor, like the Edison street mains, may be used, making contacts therewith as shown. This contact may be water and air-tight and should reduce the loss from leakage to the lowest possible degree.

Automatic Starting Switch.

To the Editor of The Electrical World.

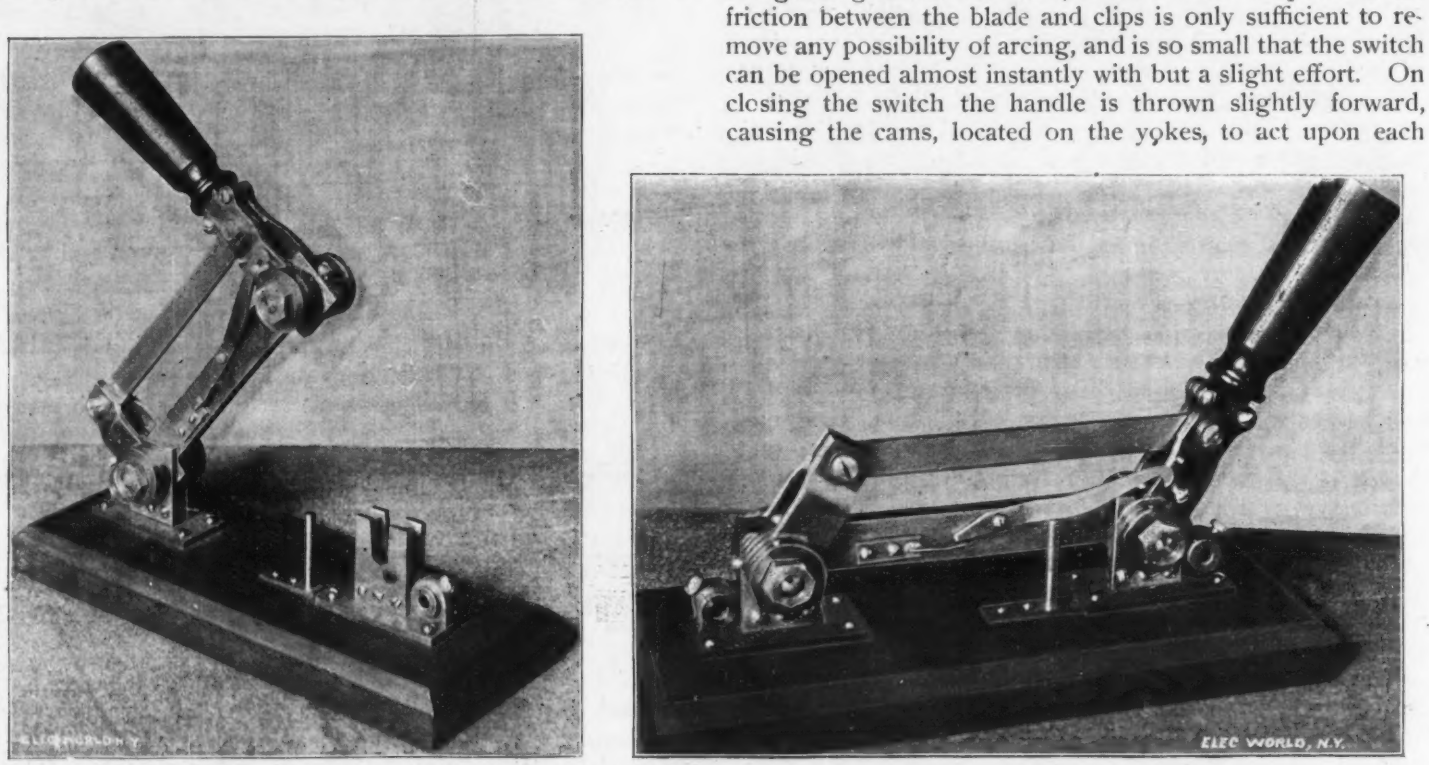
In your issue of the 26th of May you describe White's automatic starting switch for motors, which is geared to and operated by the armature shaft of the motor. As this is merely a modification of my form of control, patented both in this country and abroad, and described by me in your issue of Nov. 18, 1893, I take the liberty of calling your attention to my patent.

Baltimore, Md. G. H. WHITTINGHAM.

A New Knife Switch Especially Adapted to Circuits of Large Capacity.

Perhaps the losses due to the use of the ordinary knife switch were never more emphatically stated than at the last convention of the National Electric Light Association, held at Washington, D. C., Feb. 27 to March 2, when Mr. Edward Weston referred to the fact that "in one case a single switch and instrument involved an annual loss of $5,000." He further stated that "all resistances should be made as low as possible and great attention given to joints," and that "the switches must be made very differently from what they are now."

The switch shown in the engraving, which reduces the loss at the switch joints to the minimum, has since been patented by F. G. Bolles, 18c Decatur street, Brooklyn, N. Y. When the switch is to be opened the handle is brought to a position at right angles with the base, and while in this position the friction between the blade and clips is only sufficient to remove any possibility of arcing, and is so small that the switch can be opened almost instantly with but a slight effort. On closing the switch the handle is thrown slightly forward, causing the cams, located on the yokes, to act upon each other, thereby compressing the joints. This pressure is something enormous and the contact is in every way equal to any other bolted joint of the circuit.



KNIFE SWITCH, ESPECIALLY ADAPTED TO CIRCUITS OF LARGE CAPACITY.

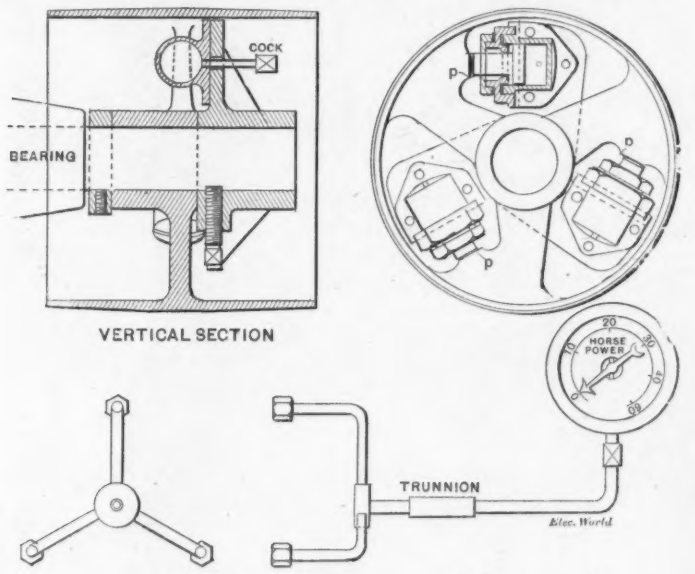
A New Type of Dynamometer.

A patent has recently been issued to J. A. Cross, of Geneva, N. Y., for an improvement in dynamometers. As in many previous instances the design was made to overcome difficulties and inaccuracies actually encountered. In this case the patentee was making a test of an electric lighting plant, using a spring dynamometer, and the readings of the instrument were proved to be wrong and the test was repeated with another dynamometer.

The main feature of the improved instrument is that instead of springs being used to transmit the power, a liquid is inserted between the two parts of the instrument and the pressure is recorded. Dynamometers which rely upon springs to transmit the power are necessarily subject to a limiting speed, and this necessitates the use of a countershaft and the subdivision of belting, thus increasing the liability to error. As the instrument illustrated is not affected by the ordinary speeds met with in practice, it requires no countershaft nor change of belting, and can be arranged within the

diameter of an ordinary driving pulley. The illustration shows an instrument capable of transmitting 75 h. p. at 10,000 revolutions per minute inside a 12-inch pulley.

The apparatus consists of a pulley having arms specially shaped, which is placed on the shaft absorbing the power to be measured, and is free to revolve on it. One half of the base of the pulley is cut away, and it does not project beyond the arms on one side, in the line of the shaft. Next to this pulley on the shaft, and securely fastened to it, is a casting having a similar number of arms to those in the pulley. Each arm carries a small cylinder having a piston with piston rod projecting through one end. The ends of the piston rods engage with the arms of the pulley. The cylinders are connected by pipes to a chamber located in line with the centre of the common shaft. Beyond this chamber is a transmission joint, permitting the pipes and chamber to rotate, while the recording apparatus, which is beyond the joint, remains stationary. The recording apparatus consists of a pressure gauge graduated in pounds or for a standard speed in horse-powers. The gauge may be located in any convenient place, and a number of separate instruments may be



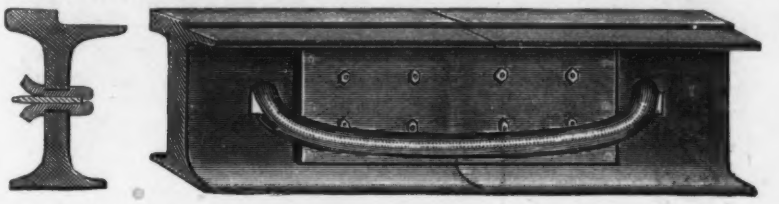
IMPROVED DYNAMOMETER.

connected to one gauge. The cylinders and pipes are filled with a liquid and the pressure exerted through it is recorded by the gauge.

The advantages of this instrument are that it is simple, not affected by ordinary speeds found in practice, and requires no countershaft and no change in the regular driving belt. It takes the place of the ordinary driving pulley and is operated by the same belt. It may be connected to a recording gauge, and a continuous diagram of load obtained without attention. It does not have to be displaced after a test is made, as by closing a valve the recording apparatus may be removed if desired, and the remainder left in place instead of the regular pulley.

Rail Bond.

The bond shown in the accompanying illustration is made by the Technic Electrical Works, 129 Broad street, Philadelphia, and is designed to give a simple and reliable rail connection with a minimum of labor. The bond is simply a soft copper rod of the same diameter as the hole in the rail, bent and split at the ends, with a steel wedge slightly larger than the slot driven into the bond at the bend sufficiently to enable the metal to be closed over it, thus preventing the wedge from backing out. The action of the wedge is to spread the soft copper over the edges of the hole in the rail, thereby accomplishing the same result as riveting, and also obtaining a perfect and permanent contact with the rail, unaffected by any vibration. As shown in the cut the bond is inserted in the web of the rail, but where the fishplate will admit it the flange can be used. The work of bonding with



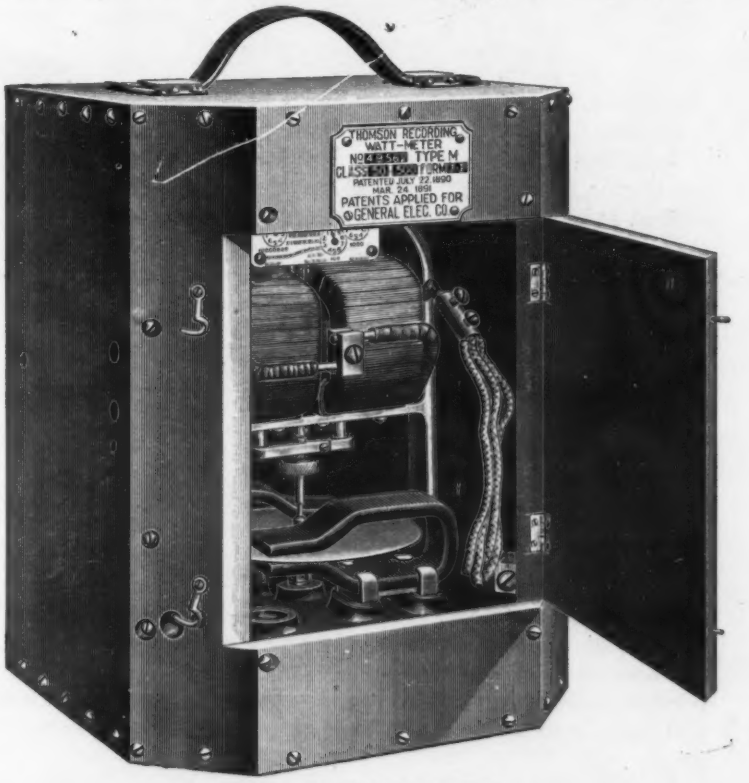
RAIL BOND.

the above device can be done very rapidly, and only a hammer and a cold chisel to open the slot at the bend in the bond are necessary.

Portable Recording Wattmeter.

The latest development in the electrical meter line is the new Thomson portable recording wattmeter, which, identical in general character with the standard meter of that type, is constructed with special provision for transportation from place to place, and for use where it is exposed to jarring and rough shaking. While it may, of course, be used for any and all classes of testing work in which a portable recording meter is requisite, its special use is for the testing of street car work, and in this field it will be found most valuable.

The meter is mounted on a skeleton frame suspended between strong elastic rubber nettings within the case. Detrimental shocks and vibrations become absorbed



PORTABLE WATTMETER.

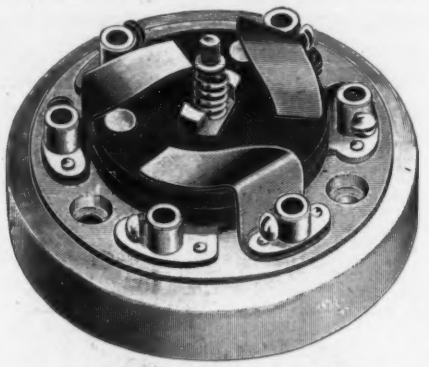
in these nettings, and no interference with the movement of the meter occurs. Its accuracy is unaffected even when placed on the floor of a rapidly moving car. The meter is mounted in a handsome polished wood case. The 25-ampere size will be found the most suitable for general car testing, as it will stand and accurately record extreme overloads for short intervals.

This meter is the result of long and careful experiment on the part of the General Electric Company. It should not be confounded with the rigidly mounted and bulky portable meters, formerly used for car testing in default of a superior device. This meter is the outcome of a demand from the

street car companies for a meter which would enable them to check the efficiency of every car equipment and the average number of horse power hours needed to take any car over any route of their systems. They are manufactured in the following sizes: Three amperes, 1 1-2 h. p.; 15 amperes, 7 1-2 h. p.; 25 amperes, 15 h. p.; 50 amperes, 30 h. p.; all for 500-volt circuits. They can also be made for any other voltage according to order.

Three-Circuit Switch.

The new Gibbs three-wire or three-circuit switch we illustrate is just being introduced on the market by the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., and is especially designed to meet the requirements of underwriters' rules. The switch is positive in action, has a quick break and a double break on each circuit, and ample carrying capacity for the current it is rated to carry. The porcelain is of a high grade and non-absorbent and the mechanical con-



THREE-CIRCUIT SWITCH.

struction is of the best, in keeping with the excellent work heretofore done by this company in the direction of switches, sockets and similar useful devices for use in incandescent lighting. The general principles of this device were described in our issue of March 31. The present switch, however, combines all the advantages there referred to and is yet well adapted to three-wire service.

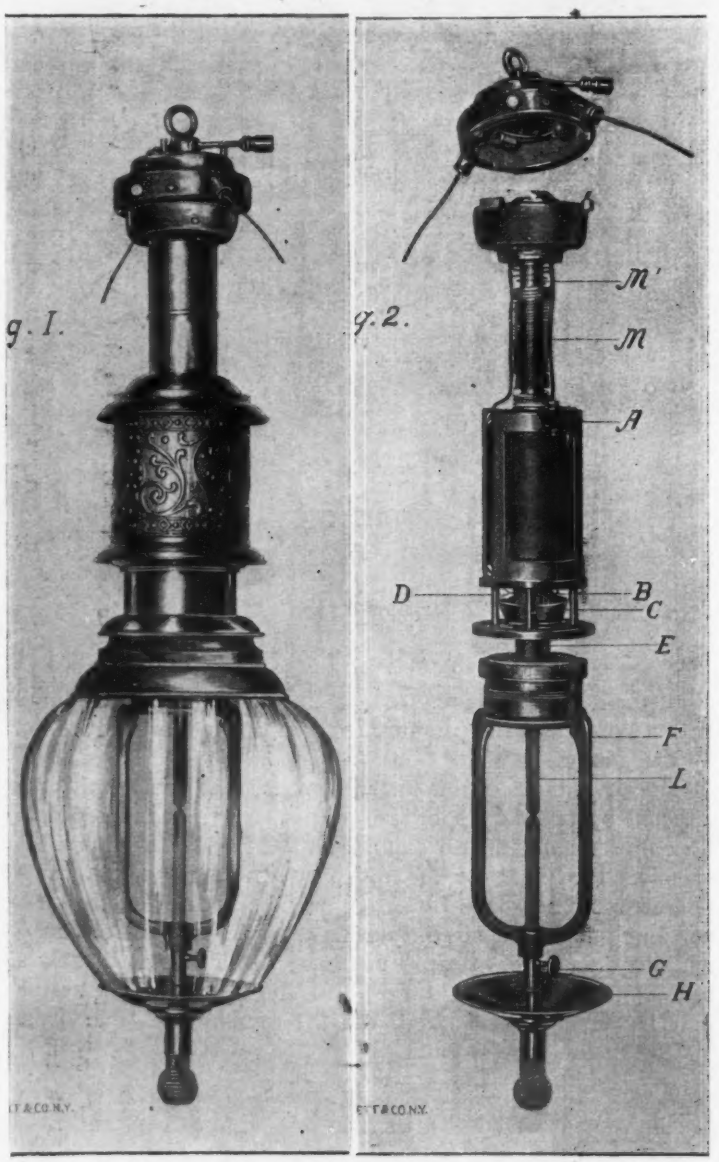
A New Arc Lamp.

A new type of arc lamp, the invention of Mr. William Jandus, is being placed on the market by the Manhattan General Construction Company, New York, for which a number of claims of superiority are made, including a great saving in trimming, simplicity of mechanism and the use of ordinary carbons for all purposes.

Fig. 1 shows the lamp complete and Figs. 2 and 3 illustrate the details. All of the mechanism and parts are concentric to the central stem, and the arc is inclosed by a globe, which is made air-tight at the top by an asbestos packing and at the bottom is closed by the yielding pan, *H*, and thus the consumption of carbons so reduced that the lamp illustrated will burn one week on half-night service without retrimming.

In Figs. 2 and 3 *A* is the magnet, *B* the armature carrying the clutch pan, *C*, and engaging, through suitable slots in the armature, the clutch rings, *D*, which have radial play within the slotted tube, *K*. In the upward travel of the armature *B*, the flaring pan, *C*, engages the clutch rings, *B*, against the inserted upper carbon, raising it to form the arc. *J* is a cast iron box containing brushes for conveying current to the upper carbons. J^1 is a sectional view of the box and J^2 shows the box with cover removed and carbon inserted, showing gravity contact of the brush rings against the carbon surface. *E* is the negative terminal casting, having an embossed cut-out seat, *P*. A cut-out ring, *N*, held out of contact with seat, *P*, by an insulated spring, *O*, is secured in the negative terminal casting, *E*. The negative carbon frame, *F*, threads into the lower part of casting, *E*. The slotted tube, *K*, passes through the opening in casting, *E*, the brush box, *J*, being screw threaded to the end of slotted tube, *K*, and insulated from casting, *E*. *G* is the negative carbon clamp, suitably insulated from a dust pan, *H*, which has yielding contact against the lower opening in air tight globe. *L* is the upper carbon holder or sheath, removable with the carbon. *M* is a resistance path to cut-out ring, *N*. M^1 (part of same resistance coil) is a shunt on the main coil of magnet to regulate the length of arc.

The circuit through lamp is as follows: The current passes from the positive terminal through the main coil of magnet into the magnet, *A*, and slotted tube, *K*, to the brushes, *J*, and clutch rings, *D*, to the upper carbon, to the lower carbon and out through the negative terminal. It is provided with two paths, one through the main coil and carbons and the other through the resistance, *N*, to the spring, *O*, and cut-out ring, *N*, to the seat, *P*, of the casting, *E*, and



FIGS. 1 AND 2.—ARC LAMP.

out through the negative terminal. An insulating washer separates the armature, *B*, from the cut-out ring, *N*, the contact between the ring, *N*, and seat, *P*, being effected by the weight of armature, *B*. The spring, *O*, allows the beveled ring, *N*, to seat itself adjustably on the embossed seat, *P*, insuring a sliding contact thereon.

The cut-out is only called into service in cases of obstruction to the prompt descent of the upper carbon, which is a

rare occurrence. In all other cases the cut-out is effected through the carbons themselves, after being consumed to the predetermined point.

To shorten the lamp the customary carbon rod has been dispensed with and a carbon sheath or holder feeding through the clutch rings with the bare carbon substituted, and though the diameter of the sheath is appreciably larger than the carbon carried, they both feed through the clutch rings without any variation in voltage. This is due to a cushioned clutch fed without the characteristic "jumps" of other lamps. If preferred, the carbon holder or sheath may be dispensed with and the carbon fed direct.

The lower carbon is secured in a socket fixed to the yielding pan. To trim the lamp the yielding pan is unscrewed, when the upper carbon follows down after the lower and is removed; to place new carbons in the lamp the upper carbon is simply shoved up into place on the point of the lower carbon through the brush rings into the slotted tube, when the pan is screwed on and the lamp is ready to burn. The clutch rings grasp the carbon radially at the upper part and the brush rings centre it at the lower, thus insuring a perfectly vertical feed and preventing wedging of carbons. The distance between the brush rings conveying current to the top carbon and the socket holding the lower is only about 8 inches, which is constant and therefore avoids variation in resistance. It will be noted that the space between the top of the globe and the mechanism has been done away with, which not only greatly reduces the length of the lamp, but makes it particularly susceptible to decoration.

It has been found that in this inclosed chamber it is possible to successfully burn a longer arc than in the open air, and, when desirable in series arc work, a 2,000-c. p. lamp can be run at about 75 volts and 6 amperes. As the 1-2-inch carbons are only consumed at about the rate of one inch in four hours, it will be seen that the lamp seldom feeds, so that aside from the feature of the sneak feed provided in this lamp the carbons are required to feed about one-fifth as often as an arc lamp burning in the open air, and are consequently that much more regular and steady in burning.

The main line circuit runs through a switch in the cap. To take down the lamp it is only necessary to give the lamp a quarter turn, when it drops out of the cap, leaving the circuit to pass uninterrupted. The wires enter the cap through inclined insulated openings, which exclude the weather.

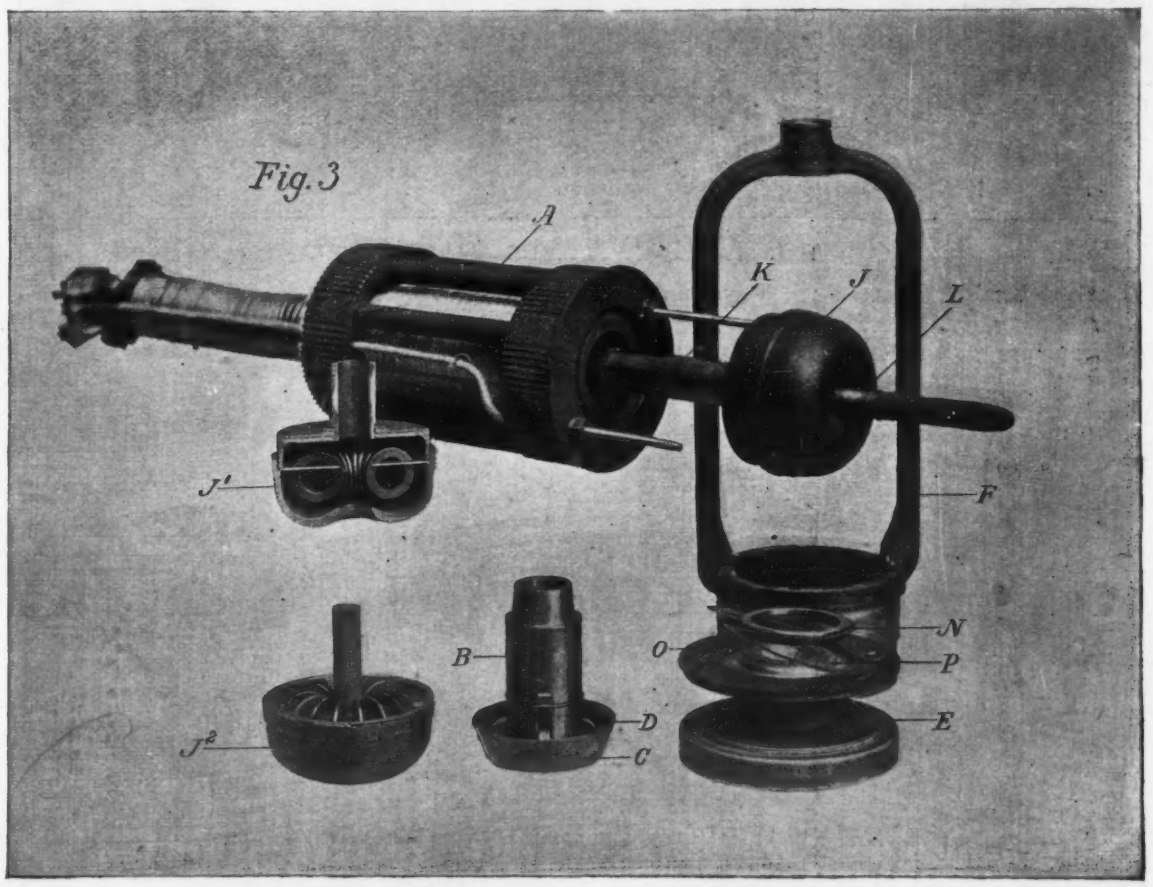


FIG. 3.—DETAILS OF ARC LAMP.

Interior Telephones.

The Interior Telephone Company, 203 Broadway, New York, which controls the Colvin system, has provided telephonic arrangements and apparatus to meet the various requirements of interior service and also for long distance work. Their "System No. 1" provides for a cheap and efficient short private line service with battery call. By combining any efficient magnetic calling apparatus with the same wall instruments, a long distance set is made up, which is known as "System No. 5."

The "No. 2" system is designed for speaking tube service in offices, buildings, factories, etc., where a central office or manager's desk wishes to call up and talk to any number of outer points in the factory, these points also to call up and talk to the office, but not to talk among themselves, except in rare cases where the manager permits them to do so.

System "No. 3" permits intercommunication between all the stations; each station can call up instantly and direct any other station, and all hands can be talking at once without interference. System "No. 4" gives the same service as does "No. 3," using wall sets instead of desk stands. These two systems can be combined. "System No. 6" provides for the use of any number of telephones along a single grounded outdoor line or a metallic circuit of any length. It is so arranged that the service is equally good with twenty instruments cut in on the line as with only three, or even two; it is

particularly appreciated by railroad companies where an immense amount of service can be gotten out of a single iron wire. This company also has a large demand for subscribers' instruments for exchange service. As no induction coil is used by the Colvin transmitter, no battery whatever is required at subscribers' stations. Such a system, if employed in New York City, where there are 10,000 subscribers, would dispense with the use of 30,000 cells of primary batteries. The transmitter is said to have talked over 800 miles of No. 6 iron wire, using about 50 volts on the main line. It has worked over a 150-mile circuit, using only 8 volts.

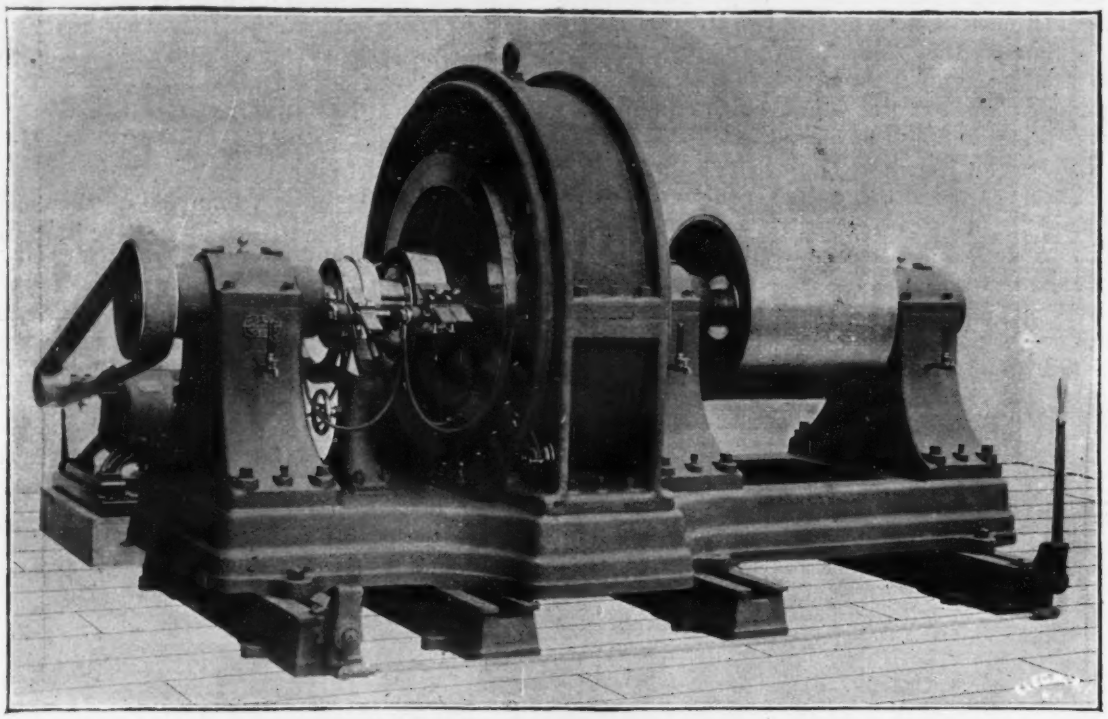


FIG. 1.—160-KW. WOOD ALTERNATOR.

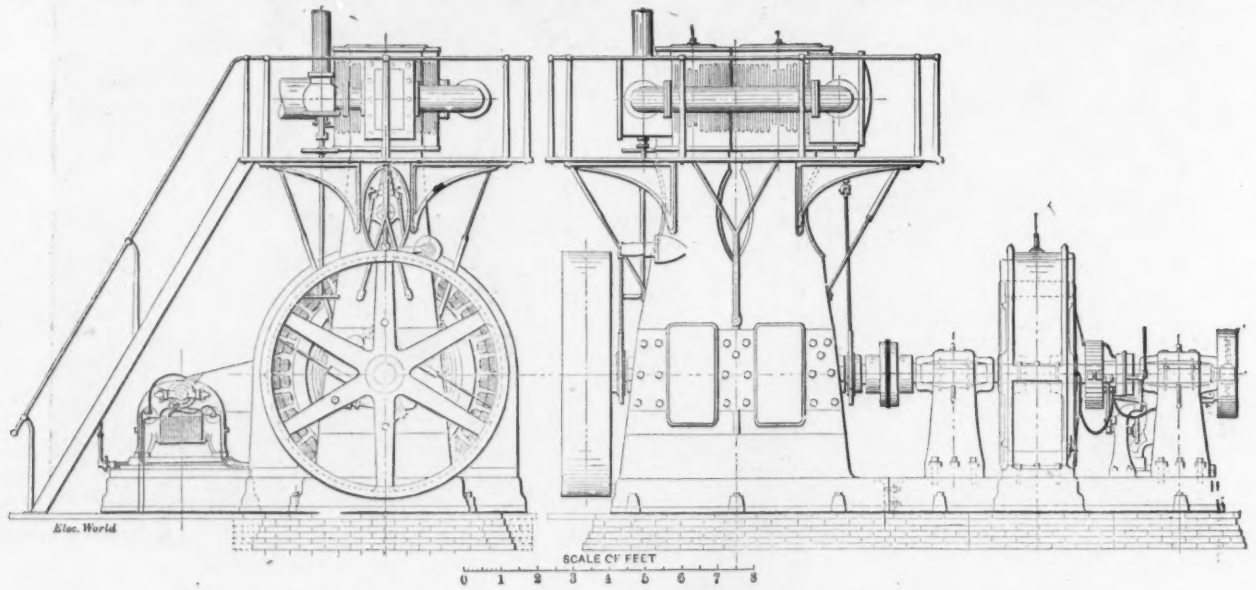


FIG. 2.—DIRECT-COUPLED WOOD ALTERNATOR AND BALL ENGINE.

New Wood Alternating Apparatus.

We illustrate herewith types of Wood alternating apparatus made by the Fort Wayne Electric Corporation. The alternating machines range in capacity from 37.5 to 300 kw., and we give a view, Fig. 1, of the 160-kw. Wood machine of this type. In the alternators the entire magnetic frame is cast, the pole pieces being slotted near their tips to prevent the generation of Foucault currents, the slots being cast and not milled. These pole pieces have slipped over them a compound coil of copper wire, which is composed of four layers of comparatively small wire connected in series with the exciting dynamo, and over these two layers of heavy wire, through which the rectified portion of the main circuit passes. By this method compensation or over compounding for any line loss is made good, automatically and instantaneously.

The armature of this alternator is made up of C-shaped stampings; it is of the ironclad type, the teeth of which are wound with a very few turns of copper ribbon. The induction in the teeth is about 8,000 lines per square centimetre, and the length of the conductor on the armature is 3.6 inches per volt. The electrical efficiency of the machine is 95 per cent. The initial excitation is produced by a small exciter driven from a pulley on the end of the main armature shaft.

The converter complete, and also taken apart, showing its interior construction, is illustrated in Figs. 3 and 4. The coils, after being wound, insulated with mica and baked, are tested to 5,000 volts, alternating between primary and sec-

ondary. They are then stacked; that is, the iron core is inserted.

After the core is in place semi-cylindrical wooden pegs of maple, boiled in special compound, are driven in to set up the coil and keep the iron core in place. This method of clamping the iron core does away with the necessity of all bolts, screws or special clamping plates. After the stacking is finished, the coil is again subjected to the 5,000-volt test; if found in good condition it is put in the iron case, the line

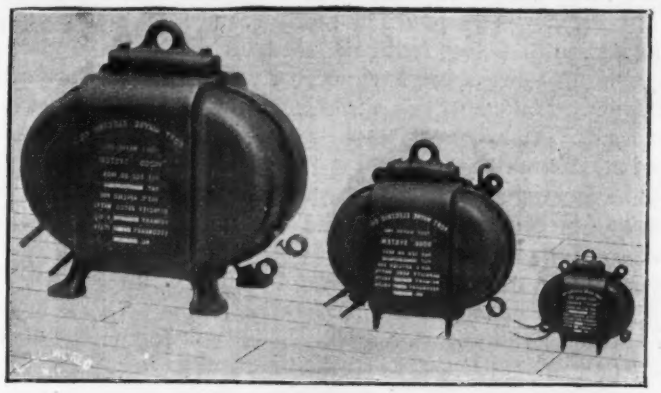


FIG. 3.—WOOD CONVERTER.

wires soldered to it, and the case hermetically sealed. The coils are again tested for contact between primary and secondary and then for contact between primary and secondary, and core and frame. They are then run 10 hours at full load at their normal potential.

In the new design of transformer Mr. Wood has made

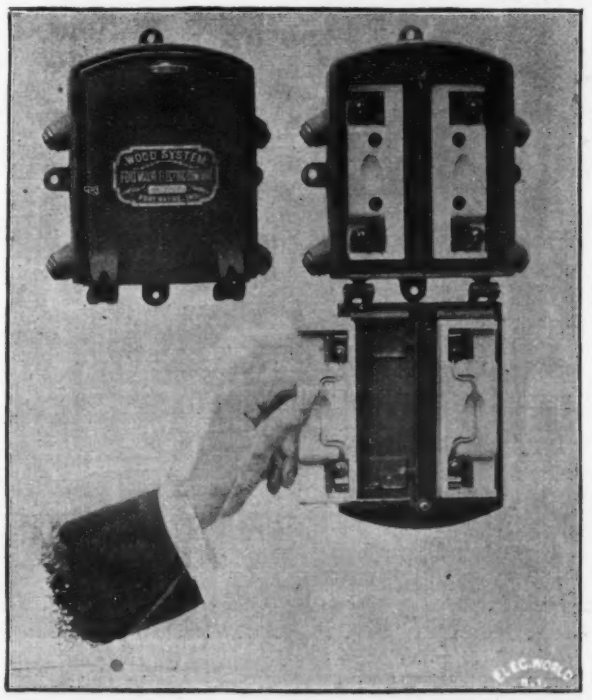


FIG. 5.—WOOD DOUBLE-POLE PRIMARY FUSE BOX.

special provision for ventilation. As will be seen, the inside of the transformer case is provided with little offsets, against which the transformer core rests and which thus leave an air space between the core and casing. The bottom and top of the case are provided with openings, that at the top being covered by a weatherproof cap. Owing to this construction a continuous stream of air can pass through the transformer without leading to any deterioration of its insulation. It will also be noted that by this construction the case is made part of the magnetic circuit, and, far from seeking to insulate the core from the casing, the coil and the core both are held in place by the case bolts.

Attention has also been given to a small but important detail, that is, the handling of the converter on pole lines, side walls, etc. In the first place, the converter case is provided at the top with an eye bolt, by which it can be readily lifted to the desired point. That point being reached, as, for instance, the cross-arm of a pole, the converter can then be immediately lowered to its final position and its suspension maintained by two special swivel suspension hooks. Resting on these hooks the final securing with lag screws can be done at the convenience of the linemen. For temporary work the converter can be placed in position solely by means of these suspension hooks and be moved in the shortest

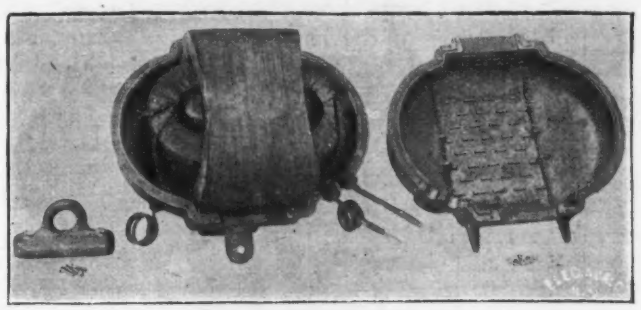


FIG. 4.—DETAILS OF WOOD CONVERTER.

possible time. The converters are also provided with feet so that they can be stood up on the floor when desirable.

The Wood double-pole primary fuse box, shown in Fig. 5, is designed with special reference to safety for the lineman, and ease in inspecting and replacing a burnt-out fuse. As will be seen, the fuses are mounted on the cover in porcelain block and in such a way that they can be readily slid out for renewal. The very act of opening the cover breaks the circuit on both sides of the line, so that there is no danger of shock from a possible ground.

The porcelain fuse blocks, as will be noted, are hollowed out at the middle point of the fuse, and the object of this

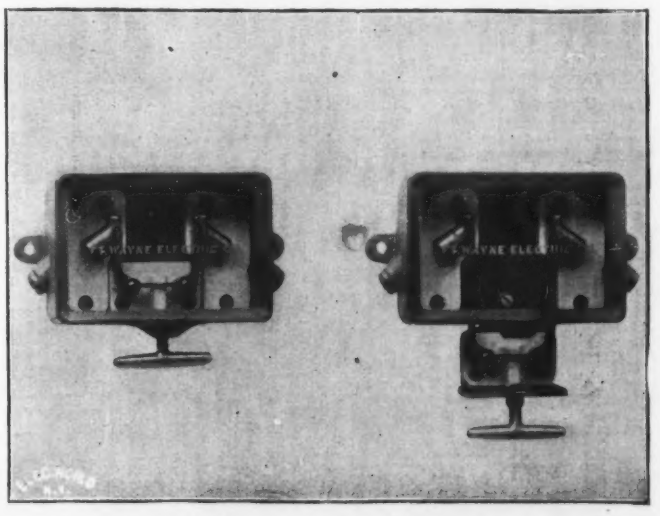


FIG. 6.—WOOD SINGLE-POLE PRIMARY FUSE BOX.

air chamber is to cause the fuse to blow at that point, owing to the porcelain keeping the fuse cooler in its contact at the ends on either side of the air chamber than in the free central part. By blowing at the centre the contact terminals are preserved intact.

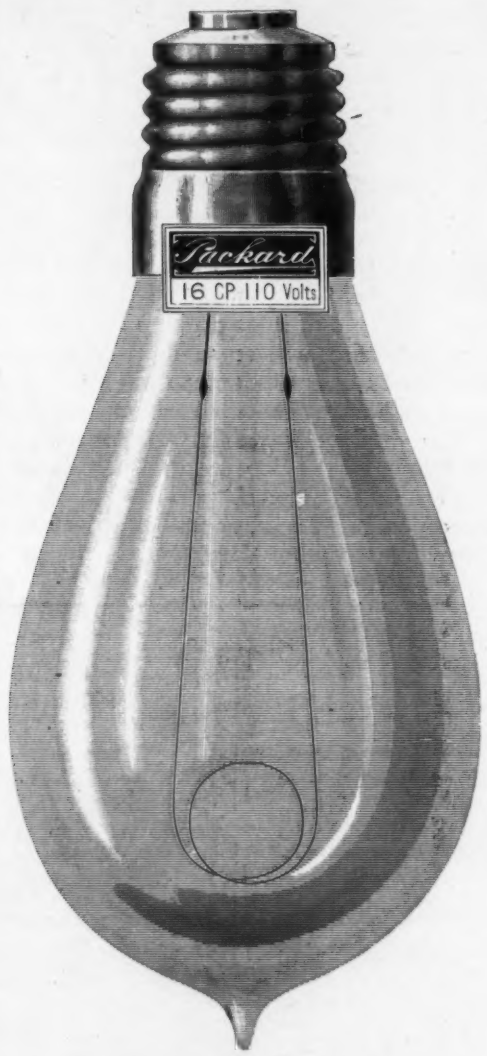
Special provision has also been made to secure good contact between the fuse and the line terminal, and this is accomplished by stiff springs placed under the clamping nuts in the switch box. It will also be noted that arcing across from one side of the line to the other is prevented by a rib in the box between the fuse blocks, which fits into a corresponding groove on the cover.

The Wood primary branch single-pole fuse box and the manner of withdrawing the fuse block for renewal are shown in Fig. 6, the contacts being made automatically.

The new Wood 160-kw. compound alternator and exciter, coupled to a 300-h. p. vertical cross-compound engine, built by the Ball Engine Company, of Erie, Pa., and running at 240 revolutions per minute, is shown in Fig. 2.

New Packard Lamp.

The latest departure in the Packard lamp line is the coiled filament Packard lamp, shown herewith. The cut is an exact representation of the lamp as to size, shape, etc., and shows the graceful outline and general symmetry of the lamp, which are among its features. The New York and Ohio Company, Warren, O., the manufacturers of the coiled



NEW INCANDESCENT LAMP.

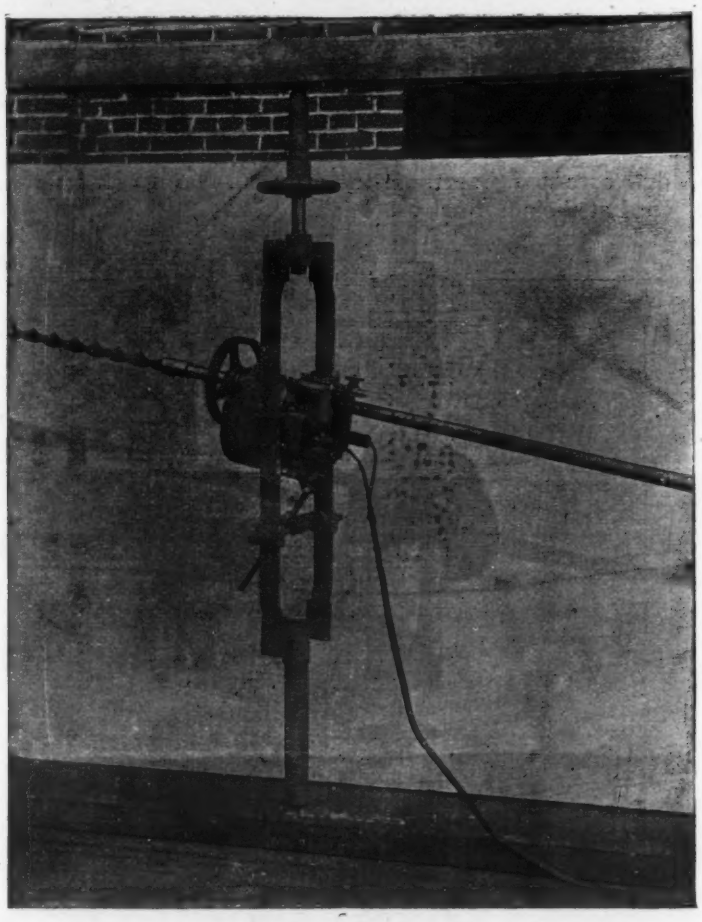
filament lamp, has moved slowly in bringing out a lamp of this kind, preferring to wait until it had fully satisfied itself that it was the more desirable lamp under certain conditions. When convinced of this fact, it proceeded to make a coiled filament lamp that would be in every way efficient and sightly. The lamps are particularly adapted to high voltages, and at present are furnished only in lamps of from 100 to 110 volts. The coil, in addition to concentrating the light, also prevents the filament from falling against the bulb and shortening the life of the lamp. Further than this it renders the filament more rigid and less likely to be affected by the jarring of the building or its support, and gives a longer life in buildings which are subject to vibration from the operation of machinery or other causes.

An Electric Power Drill.

An electric auger drill has been brought out by the Jeffrey Manufacturing Company, Columbus, O., whose experience with electric and other mining machinery insures that all the necessary points involved have secured careful attention in the design.

The drill complete for bituminous mines, including post for 6-foot mine, foot bar, adjusting clamps, girth, etc., weighs 160 pounds and is capable of developing from 4 to 5 h. p. at the auger. This power is rarely required, not more than 2 to 2 1-2 h. p. being, as a rule, used, but as the drill must be capable of doing a great variety of work, this machine was designed to take at times 7 to 8 h. p. without excessive strain or injury. It had been tested thoroughly under this heavy load and showed no signs of sparking or excessive heating.

The largest size drill, which looks practically the same as the one illustrated herewith, has a normal rating of 4 mechanical horse power. It has been tested in rock and sandstone up to 9 h. p. without undergoing any strain. This machine was designed with a special view to the requirements of anthracite mining, for trimming gangways, taking down roof and general rock work. The advantages of having a



ELECTRIC POWER DRILL.

machine of this class in an anthracite mine will be appreciated by the fact that this machine will drill a 2-inch hole 6 feet deep in the hard "boney" found in anthracite mines in from two to two and a half minutes' time, taking an average of 17 amperes at 220 volts. Drilling in the coal proper this machine will drill a 2-inch hole 6 feet deep in 50 seconds.

The motor, as will be seen from the illustration, is well protected by being enclosed in a steel casing on the sides and by a steel plate on the side facing the coal or material to be drilled. This plate is carefully fitted on the motor, so that it is practically impossible for pieces of dirt to get inside the frame and injure the armature or field coils. The real end of the motor is covered by the switchboard. The armature is perfectly waterproof, drum wound, with slotted, lami-

nated discs. The commutator has a large number of segments, which reduces the tendency to spark; it has also large surface for brushing contact, insuring freedom from repairs. The motor has two spools, one on the top and one at the bottom, the top spool having about twice as many turns as the lower spool. This arrangement allows a much lighter machine to be constructed, and at the same time there is a well balanced field, which cannot be obtained where only one spool is used. The efficiency tests of these machines showed that the smaller size had 77 per cent. commercial efficiency and the larger size 80 per cent.

Armature Winding.

The depreciation and cost of repairs of electric light and power apparatus are a most important item, and it is essential therefore that great care should be taken in their construction. This is particularly true of the armatures of the machines. In the winding of drum armatures the coils are often put on in an unsystematic manner, with large quantities of canvas and paper, intended, oftentimes, to present a good appearance rather than provide for good insulation. In order to produce a drum armature that should be perfectly balanced mechanically and with plenty of ventilation, Mr. S. W. Rushmore, 126 Liberty street, New York, has designed the system of drum winding shown in the accompanying illustrations.

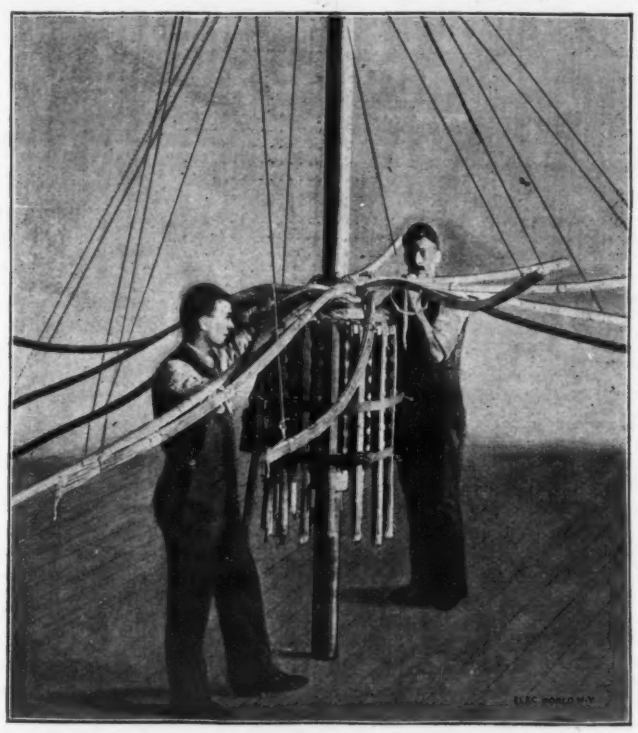


FIG. 1.—ARMATURE WINDING.

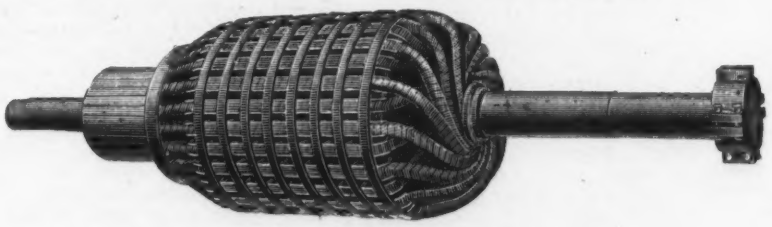


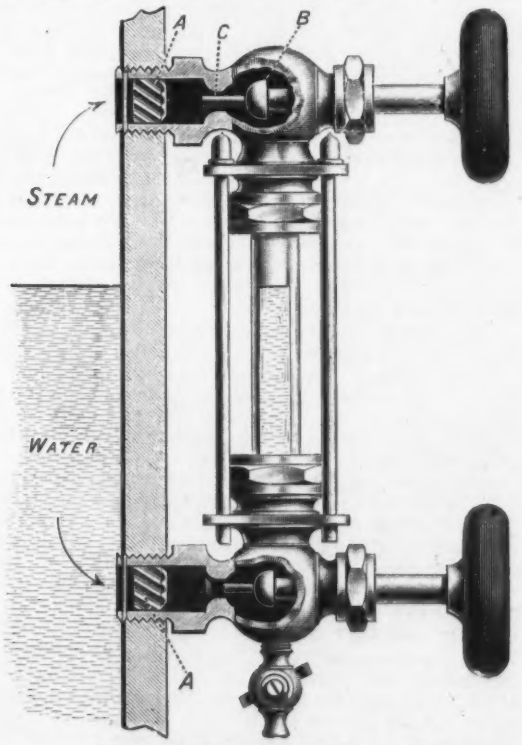
FIG. 2.—ARMATURE WINDING.

In this winding the coils are first all cut to the required length and are placed upon the armature in equal positions while standing vertically, and are shaped upon each other in such a way that they all cross the heads in a peculiar spiral manner, so that every coil is of exactly the same shape and none of the wires cross, but gradually lap past each other.

It will be seen that the coils are practically independent on the heads and that they lay in such a manner that should the insulation become charred, there is no mechanical strain to produce a short circuit. It will be readily understood that with the coils exposed to the air at nearly all points, an armature wound on this system will carry a much larger current with safety and that having the coils exactly alike in shape and position on the core cannot but be an advantage, mechanically as well as electrically.

Automatic Water Gauge.

The accompanying illustration is a sectional view of a new automatic water gauge, manufactured by the Ashley Co-operative Engineering Company, 136 Liberty street, New York, which, in case the glass breaks, obviates danger from scalding or lowering the level of water, should this occur at night with banked fires. In the pipe leading to the glass gauge is a round plug or valve, *A*, having on its outer radius spiral wings or flanges. As long as the glass in the gauge remains whole the water on the lower end of the gauge is balanced at the water line by the steam in the upper part of the gauge. As soon, however, as the glass breaks from any cause the rush of steam and water to the atmosphere carries the sliding valve to the seat, as shown. Should sediment lodge in the pipes by the valve it can be immediately removed by partially closing the valve, *B*, which governs the entrance of water to the glass, and opening the pet cock at the bottom of the gauge; this allows the revolving valve to start for its seat, but the face of the valve coming against the pin, *C*, before it reaches the seat and the steam having a vent through the pet cock to the atmosphere, rapidly revolve the valve, thus cutting loose any sediment which may have lodged there and blowing it through the gauge into the air. By adjusting the pin on the end of the outer valve so that the steam gets a vent through the valve seat and alternately opening and closing the outer valve the steam rapidly revolves the inner valve or rotating valve; and as it comes to its seat revolving it regrinds the valve seat each time the process is repeated and at the same time cleans the valve chamber completely from sediment.



AUTOMATIC WATER GAUGE.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, June 23, 1894.

THE ELECTRICAL STOCK MARKET has had few manifestations of activity during the week ending to-day, and its course has been unattended by any development of consequence to any one stock.

GENERAL ELECTRIC has been strong at various times on buying that was mainly for the bear account. The inability to depress prices even upon the many detrimental rumors attending the Fort Wayne Electric's connection, demonstrated to the bear traders the great strength inherent to the stock at the present moment, and they have hastened to get out with as little loss as possible of the trades on the down tack made when the Fort Wayne entanglement was first made public. Some items of gratifying interest to friends of the property were announced this week. The most important fact in connection with the General Electric Company that has made its appearance in recent days is the practically official promulgation that the General Electric Company has paid off its last outstanding note, amounting to some $120,000, and, after thus liquidating the last of its floating debt, with the exception of indirect liabilities, amounting to less than $300,000, of endorsements on its bills receivable, it had on hand $600,000 cash, with collections reported improving every day. Then business is constantly getting better. Both the Lynn and Schenectady payrolls are getting larger, and some important contracts have been secured. The largest is to furnish the electrical equipment for the Metropolitan Elevated Railroad, of Chicago, which will be operated by the system so successfully experimented on on the Intra-mural Elevated Railway, exhibited at the World's Fair last summer. The successful employment of this system on the Chicago road has in it much of promise in the way of the extended introduction of the General Electric's transit patents. Then the company is arranging to do away with the expensive habit of owning controlling interests in subsidiary companies by their sale upon much the same plan as the Cleveland, Ohio, property was disposed of, where the bonds were sold to bankers with certain voting powers for a number of years, while the General Electric retains a controlling interest in the stock, which is temporarily disfranchised. A number of negotiations of this character are about ready to be announced. Construction work for the proprietary companies will, of course, continue to be done by the General Electric Company. The bears endeavored to make some capital out of the statements of a Boston capitalist, who issued the following as the results of some recent travels in the Northwest: "About the worst connection of the General Electric Company is the Northwest General Electric Company. In the boom towns on the Northern Pacific road and in the far Northwest, the Northwest General Electric Company constructed electric railroads, and it has now taken up entire plants, including the rails, and placed them on storage, as the roads did not earn their operating expenses." When it is remembered, however, that the entire holdings of Northwest stock were valued in the recent annual report at $1, this kind of talk does not have much effect. The directors meet soon to elect a successor to General B. F. Peach, who resigned his position as treasurer this week, because he has been offered a better position; some say because "he is not in accord with the policy of removing the company's forces from this city to Schenectady."

WESTINGHOUSE ELECTRIC common stockholders do not, after all, it seems, receive a dividend at present. The directors have met and declared the regular dividend of 1¾ per cent., payable July 2, on the preferred stock, but no mention was made of any distribution of profits among stockholders. The directors may meet again this week, but all hope of a common stock dividend at present has been dissipated. There has been no movement in the stock for weeks. It hangs quiet around 36½@37, and, if a dividend were seriously expected any more, it would long ago have discounted the matter by crossing 40. Some damage has been done by the recent floods to the new works near Pittsburgh, but the new factories, which are expected to enable the company to turn out electrical equipment far below ruling prices, are to be ready anyhow by the fall.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees are fast retiring the issue of preferred stock. They purchased this week another lot of 512 shares at an average price of $97.50, as against an average price of $97.41 June 5 for 513 shares, $96.09 for 624 shares on May 20, $97.33 for 627 shares April 27, and $97.54 April 2 for 2,054 shares, making a total of 10,980 shares of preferred stock purchased to date, and they have set aside another $50,000 for similar purchases, thus showing the big profits they are reaping from last year's investment.

THE EDISON ELECTRIC ILLUMINATING companies have been busy this week declaring dividends. The New York company ordered a payment on Aug. 1 of a quarterly distribution of 1½ per cent. The Brooklyn company has declared a quarterly dividend of 1½ per cent., payable July 16, and the Philadelphia people make a similar payment of 2 per cent. on June 30. The stocks of all three companies rule very strong.

AMERICAN BELL TELEPHONE advanced a couple of points this week on the passage a week ago by the lower branch of the Massachusetts Legislature of the bill to increase the capital stock to $50,000,000, and the investment buying that has since set in has served to hold the stock firm at the higher quotations.

WESTERN UNION TELEGRAPH for the moment is neglected. Not that the dullness affects its quotation unfavorably, as the declaration last week of the regular quarterly dividend has more than ever disposed small investors in its favor. But just at present nothing is doing.

THE MEXICAN TELEGRAPH COMPANY has declared a dividend of 2½ per cent., payable July 7. There is a surplus for the quarter after paying the dividend of $16,978, making the total surplus on hand $388,298.

THE CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY also declared a quarterly dividend of 1¾ per cent., payable July 2. After paying this dividend there is left out of the quarter's earnings a surplus of $20,562, making a total surplus of $550,583.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric Co	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co	100	—	50
* Edison Electric Ill., New York	100	99	100
* " " " Brooklyn	100	101	102
" " " Boston	100	115	118
" " " Chicago	100	135	145
* " " " Philadelphia	100	128	130
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com	15	15	17½
" " " " " pref	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	35	35¼
Interior Conduit & Ins. Co	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com	50	36	37
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	100	106	107
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5's	100	86½	86¾
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	198½	199
American District Telegraph	100	—	—
American Telegraph & Cable	100	88	89
Central & South American Telegraph	100	—	—
Commercial Cables	100	125	—
Gold & Stock Telegraph	100	—	—
* Mexican Telegraph	100	—	—
* Western Union Telegraph	100	82⅞	83⅛

* Ex. div.

New Incorporations.

THE BI-METALLIC ELECTRIC TRANSMISSION COMPANY, Plainfield, N. J., capital stock $100,000, has been formed.

THE NASHVILLE TRACTION COMPANY, Nashville, Tenn., has been incorporated by Francis W. Hunter and others.

THE COLUMBIA MOTOR COMPANY, Chicago, Ill., capital stock $1,000,000, has been incorporated by Walter E. Sparks and others.

THE DIAMOND ELECTRIC COMPANY, Peoria, Ill., capital stock $60,000, has been incorporated by John H. Francis and others.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Norway, Mich., capital stock $10,000, has been incorporated.

THE MUTUAL TELEPHONE COMPANY, Wichita, Kan., capital stock $100,000, has been incorporated by Geo. W. Dixon and others.

THE BERKELEY ELECTRIC LIGHTING COMPANY, Berkeley, Cal., capital stock $100,000, has been incorporated by Walter E. Sell and others.

THE NEW ORLEANS CONSTRUCTION COMPANY, New Orleans, La., capital stock $50,000, has been incorporated to do electrical and other construction work.

THE DANVILLE TELEPHONE COMPANY, Danville, Va., capital stock $20,000, has been incorporated by W. A. Taylor and others, and will establish a telephone system.

THE LOUISIANA AUXILIARY FIRE ALARM COMPANY, Limited, New Orleans, La., capital stock $100,000, has been formed for the manufacture of electrical apparatus.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Pensacola, Fla., has been incorporated to erect an electric light and power plant. T. E. Welles is among those interested.

THE SOLAR ARC LAMP COMPANY, New York, capital stock $25,000, has been incorporated by Jacob Rice and others, and will manufacture electrical appliances and machinery as well as arc lamps.

THE EAGLE GROVE ELECTRIC COMPANY, Eagle Grove, Iowa, capital stock $30,000, has been formed to supply electric light, heat and power. A. T. Hess, J. A. Innis and W. H. Carman, all of Des Moines, Iowa, are interested.

THE FREDERICKTOWN ELECTRIC AND MANUFACTURING COMPANY, Fredericktown, Mo., capital stock $6,000, has been formed to erect an electric light and ice plant. Michael Deguire, H. Otto Thost, W. R. Nifons, all of Fredericktown, are interested.

THE MONTEREY POWER COMPANY, Monterey, Cal., capital stock $100,000, has been formed to generate and furnish electric and

other power. The promoters are P. Oyer, O. S. Trimmer, Pacific Grove; H. A. Greene, J. S. Metteir and Juan Malarin, Monterey, Cal.

THE GORDON-BURNHAM BATTERY COMPANY, Portland, Me., capital stock $1,000,000, has been incorporated to do a general electric light, heat and power business. W. G. Burnham, R. W. Gordon and C. L. T. Stedman, all of Boston, Mass., are the promoters.

THE DOBBS FERRY LIGHT, HEAT AND POWER COMPANY, Dobbs Ferry, N. Y., capital stock $150,000, has been incorporated by Geo. C. Todd and others. This is a consolidation of the Irvington and Greenburg Gas Company and the Dobbs Ferry Lighting Company.

THE FLORIDA ENGINEERING AND CONSTRUCTION COMPANY OF CHICAGO, Chicago, Ill., capital stock $150,000, has been formed to construct railway, telegraph and telephone lines, electric lighting and power plants, etc. Daniel E. Ryan, A. T. Otto and Morgan Cowan are the promoters.

THE GOLIAD WATER POWER COMPANY, Goliad, Tex., capital stock $30,000, has been formed to supply that town with electric light, heat, water and ice. The interested parties are W. E. Campbell, I. P. Kibbe, G. W. Simmons, C. H. Baker, H. Linburg, F. R. Starr, Jr., Goliad, Tex.

THE TREMONT AND PINEGROVE ELECTRIC LIGHT, HEAT AND POWER COMPANY, Pinegrove, Pa., capital stock $33,000, has been formed to supply light, heat and power by means of electricity. The promoters are J. E. Wernts, A. Gilbert, Pinegrove, and W. M. C. Hack, Tremont, Pa.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 25, 1894.

NIKOLA TESLA has received from Columbia College the degree of LL. D.

HOUSTON & KENNELLY have been appointed electrical engineers to the Cataract Electric Company, of Buffalo.

MR. E. A. LOWE, the genial manager of J. Jones & Son, 67 Cortlandt street, is spending his honeymoon at present with his bride of a few days. Mr. Lowe has our best wishes for a long and happy career.

REV. AND MRS. CHARLES HENRY BUCK, of Brooklyn, have issued cards for the marriage of their daughter Sara to Dr. Albert C. Crehore, Assistant Professor of Physics, Dartmouth College, on Tuesday evening, July 10.

MR. O. FARSTAD, of the General Electric draughting force, at Schenectady, spent Saturday in this city. Mr. Farstad has for some time been closely identified with the power station appliances recently perfected by the General Electric Company.

LIEUT. MANNING K. EYRE, assistant to the selling manager of the General Electric Lamp Works, at Harrison, N. J., has started on a business trip through Ohio, Tennessee and Kentucky. Lieutenant Eyre, besides his business qualifications, is thoroughly conversant with the technical details connected with the manufacture and economical operation of incandescent lamps. Two articles by him on the latter subject, which appeared in our columns, were reprinted in several of the European technical journals, and as he has made this feature a subject of special study, his advice in regard to a point of increasing importance in central station economy will be found useful by station managers whom he may visit.

NEW YORK ELECTRIC CLUB.—About 30 gentlemen connected with the electrical industries met at dinner on Thursday evening of last week in a private dining room of the Imperial Hotel to discuss the question of reviving in some form the New York Electric Club. Mr. H. Ward Leonard presided, and Mr. T. C. Martin acted as toastmaster. The subjects of toasts extended beyond the objects of the meeting, and the happy responses assisted in rendering the occasion a very enjoyable one. Among those who enlivened the evening with remarks besides the two just named were Major D. T. Everts and Messrs. R. T. Lozier, C. D. Shain, S. L. Coles, C. O. Baker, H. L. Webb, P. H. Alexander and B. E. Greene. The desirability of re-establishing the Electric Club, but in a somewhat different shape from what it was originally, was generally acquiesced in, and a committee to devise ways and means to accomplish that object was appointed, consisting of Messrs. Bartlett, Shain, Alexander, Porter, Webb, Everts and Baker. Among others in attendance besides those mentioned were, E. G. Bernard, W. J. Cook, F. R. Chinnock, George Cutter, W. J. Johnston, L. H. Orr, T. C. Perkins, E. F. Peek, H. N. Powers, F. W. Royce, H. H. Reece, P. Rosenstamm, H. J. Smith, C. E. Carpenter and C. E. Chapin. A number of others subscribed to the dinner, but were prevented from being present.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 23, 1894.

THE PHILLIPS INSULATED WIRE COMPANY, of Pawtucket, R. I., is kept busy running day and away into the night in its endeavors to keep up with orders for its "Ideal" insulated copper wire and other manufactures.

MR. A. A. KNUDSON, of the New York office of the Phillips Insulated Wire Company, of Pawtucket, R. I., was in Boston this week. His visit was in connection with some special and quite large orders for "Ideal" wire, and while he did not say that he was victorious, he looked it.

THE BOSTON INCANDESCENT LAMP COMPANY, will continue to manufacture series lamps with rod-like burners, which it claims do not infringe. Mr. H. L. Merritt, selling agent for the company sailed for Europe on the 23 inst. for the purpose of disposing of the English, French, German and Belgium patents held by the company.

THE EASTERN ELECTRIC CABLE COMPANY, of Boston, announces its regular semi-annual dividend of 3 per cent. on its preferred stock, payable July 2, to stockholders of record June 25. Good articles always lead to good business, good business to dividends, and this is the tribute that may be justly awarded this company and its manufactures.

THE AMERICAN TOOL AND MACHINE COMPANY, 84 Kingston street, Boston, is very busy at the present time, its offices presenting unusual activity. President Huxley and Superintendent Hoffman believe in energetic and effective work, and it is needless to say that Messrs. Barker, Whipple and Lincoln, old officials of the company, are seconding them most heartily. There appears to be a general unanimity all around, which must produce only one result —brilliant success for this old veteran corporation.

THOMAS SMITH & CO., 14 Cypress street, Worcester, have recently added to their equipment a complete line of punches and dies for dynamos and motor armature discs, and are now ready to furnish discs of any desired thickness in diameters from 1 to 12 inches. But few concerns, aside from dynamo manufacturers, have previously been equipped to turn out armature discs in a proper manner, and it will, no doubt, be a considerable convenience to many makers of dynamos to be able to obtain finished discs of any desired dimensions at short notice.

MESSRS. HUXLEY & HOFFMAN, the former agents of the Buckeye engine, have transferred their business to Mr. W. D. Hoffman, formerly of the Standard Oil Company, who will represent the Buckeye engine for the New England district. Mr. Hoffman has had lengthy experience with the Buckeye, extending over the period during which it was built at Hartford, Conn., and will make his headquarters at 84 Kingston street. Several satisfactory contracts have already been secured, and a number of others are now being estimated upon. The agency has at its office a complete working model of the engine, showing the valves and cylinder in section, and thus enabling parties to secure a perfect idea of the many advantages the Buckeye contains for all classes of power plants.

MR. CLINTON IRVING HAGUE, of the New Haven Insulated Wire Company, was accidently drowned at Whitney Lake, near New Haven, on Saturday, the 16th. Mr. Hague was exactly 33 years old, and was well known by a large circle connected with electrical industries. Any one who has had business relations with him will testify to his upright character and his electrical and mechanical attainments, and the many friends who had the pleasure of an intimate acquaintance with him will grieve over the untimely end of a gentleman whose endearing qualities were of the highest order. His death is deplored by many New Haven local organizations, including the New Haven Yacht Club, the New Haven Naval Reserve and other social clubs in which he was prominent.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, of Hartford, Conn., with its usual promptness to meet the demands and requirements of the public and the underwriters, has designed a triple break switch, which it submits as being excelled by none, if, indeed, it is equalled by any. The well known lamp made by this company—the Waterhouse-Gamble arc lamp, for incandescent circuits, is rapidly finding its way to public favor. Among the recent installations, the Union station plant, in Boston, is important. In that case notably the pure merits of the lamp and its economy of operation led to its selection and adoption from out of a number of other and well known lamps. The constancy and regularity of the lamp are great points entitling it to consideration.

Pittsburgh Notes.

PITTSBURGH, June 23, 1894.

THE PITTSBURGH AND MANSFIELD RAILROAD COMPANY has been granted the right by the War Department in Washington to build a bridge across the Monongahela at Pittsburgh.

THE CORAOPOLIS ELECTRIC LIGHT COMPANY was chartered a few days ago with a capitalization of $5,000. Directors, W. H. Guy, George A. Lashell, H. W. Burns, A. Rose and Chas. A. Cooper, of Pittsburgh.

THE ANNUAL COMMENCEMENT exercises of the Keystone Electrical College were held last night at Carnegie Hall, Allegheny City. Mr. Leon Le Pontois, of the Westinghouse company, lectured on the subject, "What May be Accomplished by Electricity Ten Years Hence."

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has contracted with the East Pittsburgh Improvement

Company for 23 additional acres of land at Brinton, Pa., which makes 40 acres in all, to be used for the new electric plant. The machine shop is now under roof, and it is expected to begin the installation of machinery early in August.

THE EMPLOYES of the Westinghouse Electric and Manufacturing Company held their annual picnic last Saturday at Aliquippa Grove, near Pittsburgh. The outing was a very enjoyable one. A very large crowd was in attendance, and all the popular outdoor sports were indulged in. A baseball game between the "office nine" and the "shop nine" was especially interesting.

THE MONONGAHELA AND ALLEGHENY RAILROAD COMPANY has obtained a charter. The capital is $60,000. It will be about six miles long, and is intended as a connecting link between the Baltimore & Ohio Railroad and the Allegheny Valley Railroad. The directors are G. T. Richards, James Doig, L. H. Partridge, James Duncan, Jr., Wm. Smith, C. H. Sackrider and R. S. Fraser, all of Pittsburgh.

Canadian Notes.

OTTAWA, Ont., June 16, 1894.

TORONTO.—The Toronto Street Railway Company may probably extend its route to Oakville.

THE CANADIAN MINISTER OF INLAND REVENUE has recently introduced a bill in the Dominion Parliament respecting units of electrical measure, which is similar to the one before the United States Congress.

MONTREAL.—The directors of the Bell Telephone Company, acting upon the power conferred upon them by the shareholders at the last annual meeting, have decided to increase the capital of the company from $2,640,000 to $3,168,000.

HAMILTON, ONT.—On application of Dr. Bingham, on behalf of a Hamilton syndicate interested in a new street railway system, a meeting of the Board of Works has been called. The syndicate will ask permission to lay a piece of track on Herkimer street, near Locke street, the street railway company having agreed to furnish power to make a test. If the invention proves successful, it will do away with the necessity of trolley wires, a third rail being used for the transmission of electricity.

News of the Week.

Telegraph and Telephone.

OCALA, FLA.—Address the mayor concerning the company organizing to build and operate a telephone line.

MIDDLEBROOK, VA.—The Middlebrook Telephone Company, Middlebrook, Va., wants to purchase a complete telephone equipment.

DANVILLE, VA.—W. A. Taylor, Danville, Va., promoter of the Danville Telephone Company, is open for bids for a complete telephone system.

CHESTER, S. C.—The Chester Telephone Company, Chester, S. C., wants to purchase a telephone equipment. Address A. W. Love, manager.

GREENSBURG, PA.—An independent telephone company, having for a circuit Greensburg, Mt. Pleasant, Irwin, Scottdale, Connellsville and Latrobe, has been organized.

BOSTON, MASS.—The Massachusetts House has passed, to be engrossed, the bill permitting the American Bell Telephone Company to increase its capital stock to $50,000,000.

LEXINGTON, VA.—A company has been organized to erect a telephone line between Staunton and Middlebrook. J. H. Bowman is president. This company will probably, in the future, extend its line to Greenville, Moffett's Creek and Lexington.

Electric Light and Power.

ODEBOLT, LA.—The city has decided to put in an electric light plant.

MORRISVILLE, N. Y.—Morrisville is to have the electric light. The wires are being put up.

CUBA VILLAGE, N. Y.—Address the town clerk concerning a proposed electric light plant.

NORWOOD, N. Y., has closed a contract for an electric light plant to be run by water power.

KEOKUK, IOWA.—J. C. Hubinger contemplates erecting a commodious addition to his power plant.

VICKSBURG, MISS.—The Vicksburg Electric Transit and Light Company will erect an electric light plant.

SCOTLAND NECK, N. C.—S. F. Dunn and Geo. W. Coughenour intend to put in an electric light plant.

BALTIMORE, MD.—Address Hon. F. C. Latrobe, mayor, concerning an electric lighting contract for five years.

PARIS, TENN.—A $40,000 electric light plant is contemplated, and the city clerk may be addressed in relation to it.

OTSEGO, MICH.—A proposition will soon be submitted to the citizens for the establishment of an electric light plant.

SPRINGFIELD, MASS.—Address the city clerk concerning the contemplated erection of an $80,000 electric light plant.

CHATEAUGAY, N. Y., is to have a water power electric light plant, and ground has already been broken for the same.

WESTMINSTER, MD.—The Carroll Electric Light and Power Company, Westminster, Md., wants a 750-light dynamo.

BAY CITY, MICH.—The City Council proposes to enlarge the city electric light plant. It is proposed to expend $12,000 in improvements.

ATLANTA, GA.—The Atlanta Waterworks has installed a 150-light Kester incandescent machine, and a 35-light standard arc machine.

ALEXANDRIA, LA.—The clerk to City Council, Alexandria, La., has been instructed to advertise for bids on lighting the city by electricity.

BESSEMER, ALA.—The Howard-Harrison Iron Works will improve and enlarge its iron works, and substitute electricity for steam power.

COLUMBUS, OHIO.—The city clerk has been authorized to secure estimates as to the cost of putting electric fans in the Council chamber.

WINONA, MINN.—The Winona General Company will extend its line and make improvements in the electrical machinery. Andrew H. Hill is manager.

BATH, N. Y.—The Hornellsville Common Council has granted a franchise to the Canisteo Electric and Fuel Gas Company to lay pipes in the streets of that city.

BLOOMFIELD, NEB.—Horace McGregor, of Yankton, has been granted a franchise by the village of Bloomfield for an electric light plant, which he agrees to have in running order within 60 days.

MARSHALL, MINN.—An election has been called for July 3, to vote on village bonds of $25,000, to put in waterworks and electric lights. It will, without doubt, carry, and work will be done this summer.

JOLIET, ILL.—Mayor Stassen recommends that the committee on street lighting be instructed to advertise for sealed proposals for an electric light plant of 300 lights of 2,000-c. p. each, and report on Monday, July 2.

WHITE RIVER JUNCTION, VT.—The Mascoma Electric Light and Gas Company intends to make extensive improvements this summer, and will be in the market for an engine, boiler, alternator, line shafting, coupling, etc.

KNOXVILLE, LA.—The plant of the Knoxville Electric Light and Power Company has been damaged by fire. The building is destroyed, one dynamo ruined and much of the other machinery rendered worthless. Loss, $5,000; insurance $2,000.

READING, PA.—The contract for the reconstruction of the wires of the fire alarm system has been awarded to the Reading Electrical Construction Company. The contract includes 22 miles of hard-drawn copper wire and 7 miles of insulated wire.

KANSAS CITY, MO.—The business building occupied by Bernheimer Bros. & Co. will be enlarged and improved. An electric light plant will be established, and the entire building throughout will be lighted with a system of some 1,600 incandescent lamps. Geo. Schafer, Westport, Mo., is the owner.

CHICAGO, ILL.—Sealed proposals will be received by the city of Chicago until July 2 for furnishing and delivering to the city boulevard lamps, and to place the same in position upon the lamp posts along such streets and thoroughfares as ordered by the City Council. H. J. Jones is commissioner of public works.

PHILADELPHIA, PA.—The electrical committee of City Councils has granted privileges to maintain underground conduit systems and do business in the Mutual Automatic, the Central, the Drawbaugh and the Bell Telephone companies, all of which are required to place telephones free in public offices and in each school section.

KEARNY, N. J.—Sealed proposals will be received by the Board of Township Committee of the township of Kearny, Hudson County, N. J., for lighting the streets of said township for a term of five years, with electric arc lights. Bidders will estimate separately on lights of 1,200 and 2,000 c. p. There will be from 80 to 100 lights required. Gabriel B. Reid is township clerk.

NEW WHATCOM, WASH.—Sealed proposals will be received at the office of the city clerk, at the city hall of New Whatcom, Wash., for furnishing 50 lights or more, at the discretion of the City Council, for a period of three years or longer, as the Council may elect at the time of letting contract, the term to commence Oct. 17, 1894. The lights are to be of 2,000 c. p. J. K. Appleby is city clerk.

SIOUX CITY IOWA.—The city's contract with the Sioux City Electric Company expires in August, and the light committee is of the opinion that a much better contract ought to be made. The Council is considering the question of municipal lighting. Alderman Chesley, chairman of the committee, reports that a plant could be put in for $75,000.

DENVER, COL.—The County Board received the report of the committee to consider the matter of putting electric plants in the various county buildings, recommending the placing of a dynamo of 430 16-c. p. in the court house, at a cost of $1,075, and a 60-h. p. engine to cost the same amount. For the jail they recommended

a 270 16-c. p. dynamo, to cost $896. The first is a standard dynamo and the latter an Edison.

MILLERSVILLE, PA.—Sealed proposals will be received for an electric light plant by the board of trustees of the First Pennsylvania State Normal School, Millersville, Pa., until 3 P. M., July 16, 1894. Specifications and drawings will be delivered to bidders between the hours of 9 A. M. and 3 P. M. on and after June 25, 1894. Security will be required before specifications and drawings are delivered. For particulars address Dr. W. A. Drysdale, consulting engineer, Hale Building, Philadelphia.

The Electric Railway.

CRISFIELD, MD.—A company is being formed to build an electric railway.

CRISFIELD, MD.—Address the mayor concerning the proposed electrical railroad.

JACKSON, TENN.—The Jackson and Suburban Street Railroad Company will erect a new electric plant.

ALVIN, TEX.—Address W. A. Rowan concerning the construction of an electrical railroad to Velasco.

CHERRY CREEK, N. Y.—An electric railway between Randolph and East Randolph is being again talked of.

TAMPA, FLA.—J. Rush Ritter, of Philadelphia, Pa., has purchased the Tampa Electric Railroad for $70,055.

BALTIMORE, MD.—The City Passenger Railway Company will soon commence extending its road to Clifton.

ALPENA, MICH.—The City Council has granted a 30-year franchise for operating an electric railway to Andrew L. Comstock.

NEW ORLEANS, LA.—The St. Charles Street Railway Company will change its motive power to electricity, and has applied for a franchise.

PAINESVILLE, OHIO.—The Painesville, Fairport and Richmond Street Railway Company has increased its capital stock from $50,000 to $150,000.

WHITE PLAINS, N. Y.—A franchise has been granted to the White Plains, New York and Mamaroneck Railroad for a trolley road from White Plains to the Sound.

ATLANTIC CITY, N. J.—Mr. E. C. Woodward is interesting capitalists in an electric railway to run to New York on the same plans as the Chicago and St. Louis electric line.

BALTIMORE, MD.—A new electric road company is being formed to build a line from Chevy Chase to Kensington, Md. It is suggested that the line be extended to Sandy Springs, Md.

LITITZ, PA.—Work on the proposed electric railway from Lancaster to Lititz will begin before July 1, and will be completed in September. The road will eventually be extended to Manheim.

LORAIN, OHIO.—The Lorain Street Railway Company has been reorganized with a capital stock of $50,000. Thos. L. Johnson, A. J. Moxham, Max M. Suppes, F. B. Vernam and W. F. Bien are interested.

LANSFORD, PA.—The borough Council of Lansford has passed a resolution giving to the Inter-county Street Railway Company a franchise to erect, construct and maintain an electric road through that borough.

NEW BRUNSWICK, N. J.—A petition is now pending before the Raritan township committee of Middlesex County, N. J., from the New Jersey Traction Company, asking for the privilege of passing through the township.

SHENANDOAH, PA.—There is considerable discussion in regard to an electric line between Shenandoah and Ringtown. Surveys have been made, and at a meeting of citizens in the latter town $10,000 was pledged to give the movement a start.

BALTIMORE, MD.—The Baltimore City Passenger Railway Company has received a permit to construct and maintain and operate in perpetuity a double-track electric railway from North avenue, in the city of Baltimore, to Laurelville.

TOLEDO, OHIO.—Hon. Parks Foster, of Elyria, Ohio, is at the head of a local syndicate which has practically completed all arrangements for an electric line between this city and Maumee and Perrysburg, which will be in operation between July 15 and Aug. 1.

HARRISBURG, PA.—A charter was granted on June 20 to the Ambler Electric Railway Company, of Montgomery County. The line covers the principal streets of Ambler, and its entire length is two miles. Capital $12,000. The incorporators are James W. Shepp, Daniel B. Shepp and Edgar A. Murphy.

ELWOOD, IND.—The Elwood Electric Street Railway Company will at once issue bonds to the amount of $50,000 and place the same with Chicago capitalists. The money will be used to extend the lines to connect the city with all the factories, and put on new cars; also to build a line to Franklin, a distance of five miles.

DETROIT, MICH.—The Detroit Suburban Street Railway Company will build an electric street railway three miles in length, with double tracks, using girder grooved rails and paving between tracks with brick. Estimated cost $70,000. Address J. D. Hawkes, general manager, 12 Woodward avenue, Detroit, Mich.

HARRISBURG, PA.—The city will soon be connected with Carlisle by an electric railway. On June 7, at a meeting of the stockholders of the Electric Railway Company of Harrisburg and Mechanicsburg, at the board of trade rooms, negotiations for the sale of its franchises to the Cumberland Valley Traction Company were closed, and the transfer was made. The gentlemen interested are: President E. Z. Wallower, Hon. B. F. Myers, H. C. Ross, H. B. Mitchell and Naudain Hamilton, of the Harrisburg and Mechanicsburg company, and S. R. Ickes, president, and O. A. Ormsby, of the Cumberland Valley Traction Company.

Miscellaneous Notes.

HERBERT LAWS WEBB has an interesting and well illustrated article in the June number of the "New England Magazine" on "The Telephone of To-day."

ELECTRIC QUACKS.—The latest developments in the prosecution of electric quacks in England is that these gentlemen have turned on their persecutors, and are now bringing actions against various people for malicious prosecution, claiming damages for the injury done to their valuable characters.

THE TELEGRAPH IN INDIA.—A "weather and famine" code has recently been prepared by a registrar in the Indian Revenue and Agricultural Department, and some weeks ago a special line was run to the site of an obstruction which, blocking up a river, is in some danger of giving way and flooding the adpacent country. As soon as this natural dam shows sign of collapse, it is proposed to warn the threatened villagers by wire.

THE COMMISSION OF THE UNIVERSAL EXPOSITION OF PARIS FOR 1900 has adopted a general classification of exhibits, which are divided into 17 groups. Group 5 is devoted to electricity, and comprises five classes; class 23 is for apparatus for the production and utilization of electricity, class 24 for electric railways, class 25 for electric lighting, class 26 for telegraphy and telephony, and class 27 for miscellaneous applications of electricity.

NEW ELECTRICAL DEFINITIONS.—The Scranton "Republican," in a report of a trial for damages from an electric shock, gives the following as part of the testimony by experts: "'Ohm' is the term used to show the resistance. 'Ampere' is the term used to describe a volt; a voltage of 1,500 would be styled an amperage of 10. A voltage of 6,000 would be required to propel an ampere three-quarters of an inch in length through a horse into a man under those conditions."

THE ASSASSINATION OF PRESIDENT CARNOT.—While The Electrical World has never been an advocate of electrocution, to the assassin of President Carnot, and to the whole body of Anarchists whose principles lead to such a frightful crime, it would mete out the most acute punishment that electricity could be made capable of producing. The terrible suffering of the criminals first electrocuted in New York ought to be a bagatelle to what these greater criminals should be made to undergo, and the inventor who discovers some electrical method of excruciating torture for such monsters will find in us an advocate for its use.

A NEW DISCOVERY.—"Electric Power—New Discovery of Vast Economic Importance—The Earth as a Gigantic Electric Storage Battery—An Investigation Which May Revolutionize Old and Expensive Methods of Generating Power." Under the above headlines the San Francisco "Post," after a half column of similar "fireworks," gives the following description of the wonderful discovery, which by the way, has interested several local capitalists: "In the ground generator, they simply insert zincs and carbon directly in the ground without any containing vessel or cell, and saturated with a very weak solution of acids. Then when the power of the generator begins to run down, all that is required to restore full electro force is to add another supply of the fluid. By this means the carbons are depolarized without removing them from the ground, consequently the generator can be run day and night until the zincs are worn out."

THE NEW YORK ELECTRICAL SOCIETY closed a successful season on Tuesday, the 19th inst., by an inspection of the new quarters of the Postal Telegraph-Cable Company, at the corner of Broadway and Murray street. About 180 members of the society and visitors were present. The inspection was preceded by the annual meeting of the society, at which the following officers were elected: President, C. O. Mailloux; vice presidents, Dr. W. J. Morton, Dr. M. I. Pupin, Luther Stieringer, F. A. Pickernell, W. J. Barstow and C. S. Bradley; treasurer, H. A. Sinclair; secretary, Geo. H. Guy. The treasurer's report showed a balance of $107, and the secretary's report an increase during the year of 40 members, making a total membership of 350. The retiring president, Mr. Joseph Wetzler, was presented with a number of electrical books as a testimonial to his labors in behalf of the society. President Seth Low, of Columbia college, was elected an honorary member.

THE INSTITUTE FOR HOME STUDY OF ELECTRICITY has issued a catalogue descriptive of its course, and of electrical apparatus for students, schools, colleges, experimental laboratories, etc. We learn from the catalogue that there are complete intermediate and elementary courses in applied electricity, and also a business course, which are addressed to the following classes: Electrical workers, engineers and all mechanics; men with business ability and capital, large or small, or ability only, who wish to organize and manage a business enterprise; men without an entirely satisfactory trade or occupation; young men who have not chosen a business; boys who desire to acquire a knowledge of the arts and sciences, especially those that enter largely into daily life and commerce; professional and business men, particularly those who have

or represent interests directly or indirectly connected with electrical industries. The courses are in charge of Mr. N. S. Amstutz and of Mr. J. C. Lincoln, of the Elliot-Lincoln Electric Company, and a graduate of the Ohio State University. The proprietors of the Institute are the publishers of the "Scientific Machinist."

PRESIDENT FRANCISCO RETORTS.—The merry war continues between Mr. M. J. Francisco, president of the National Electric Light Association, and what appears to be a Tammanyesque electric light company in Rutland, Vt., which by a political "pull" took the street lighting from Mr. Francisco's company. In a recent letter to the Rutland "Daily Journal" Mr. Francisco pays his compliments to the enemy as follows: "In answer to the puerile and personal attack of Mr. F. M. Butler in yesterday's paper, I have to say: This man, as city judge, sits in the city court room day after day sending men to the workhouse for violating the law, and pocketing the fees that their violation gives him a chance to secure; when, however, he is called to task for violating laws, which, in order to judge others justly he should be fully conversant with, the excuse offered is that others are guilty also of a like violation. The parties he cites pay their bills honestly and conduct a legitimate business, not trying to conceal their identity to defraud creditors. The statement that his concern has complied with the law he knows is utterly false, and is simply made with the idea of bluffing through an intentional omission by putting on a bold front." Mr. Francisco charges that the rival company, notwithstanding a recent order from the Supreme Court, is still damaging and destroying property of his company by intentionally "crossing" its wires, and concludes that "the opinion or personal flings of this weak city judge is of little importance."

AN ELECTRICAL HUMORIST.—The Knoxville, Tenn., "Sentinel," relates the history of an electrical experiment by the manager of a local street railway company, which consisted in connecting a wire fence with a trolley circuit in order to keep his neighbor's geese from trespassing on his property. To follow the reporter's amusing account: "A dead cow, a flock of lifeless geese and a community of frightened, indignant people are an aspect presented by West Knoxville this morning. And all this is the work of J. C. Duncan, the alleged electrician, who has, unaccountably enough, been acting in the capacity of receiver for the Knoxville street railroad since that concern went into bankruptcy. While the public knew, in a general sort of way, that electricity in Duncan's hands is as dangerous as a small boy with a pistol, yet his amiable smile and jolly disposition kept him so enshrined in the public heart that his inefficiency has been obscured somewhat by his many good qualities. That the innumerable wires hanging over every street in the city, and put up under such clumsy direction, are a constant menace to life and property is another well known fact, but Dunk long since received a title to the city as a prize for the most popular man, and the public has grown accustomed to staring electrocution in the face. It is generally supposed that the popular receiver—for with all his faults people love him still—had perpetrated about all the outrages known to street railroad management or discovered by electrical science. But Dunk's resources are, practically, without limit in this direction." According to the reporter, a Mr. Himshaw had "the sox knocked off him" in attempting to disconnect the wire, and the fears of the thoroughly aroused neighborhood were increased by a supposed additional danger from an approaching thunderstorm, when finally Professor Ferris, of the University of Tennessee, "bravely ran forward with a hatchet, during the volley of lightning flashes, and cut the wire, thus breaking up Dunk's death trap and putting an end to one of the most outrageous outrages ever perpetrated in a civilized community by a man who is allowed to go around daily without a guardian." The owner of the cow sued for and obtained damages, and at the trial some interesting facts about the killing qualities of electricity were related by Mr. Duncan. He stated that only three amperes of current were on the fence, and that three amperes would not kill a cow nor a man. All of his "motormen and linemen," he said, "had taken over four amperes without its hurting them," and his line foreman "had received the full current from three T.-H. 500-volt generators at the power house, without its injuring him further than burning his hands a trifle."

Trade and Industrial Notes.

THE CHERRY CHEMICAL COMPANY, manufacturer of the Red Seal boiler compound, has removed its main offices to the Betz Building, Philadelphia.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has closed a contract with the Metropolitan Electric Company, Reading, Pa., for the iron roof and travelling crane of a new power station.

THE MILLER MANUFACTURING COMPANY, Philadelphia, Pa., on account of the large number of orders on hand and unexpected delay in manufacture, will be unable to supply any of its gauges to the trade before July 1.

THE BELKNAP MOTOR COMPANY, Portland, Me., has received the contract for the electric light plant for the Marine Hospital. The contract called for one 20-h. p. engine, one 26-h. p. boiler, feed-water heater, boiler feed pump and two dynamos of 100 lights each.

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, reports that it is having excellent success with both the Imperial dry battery and the Burnley cartridge battery, which are being largely adoped for use by telephone companies. An addition to its factory for the battery department has just been completed. The tempered copper department has also been rushed with orders for commutator parts, showing that the trade appreciates the fact that segments made by this company's process are not only all to gauge, but both harder and smoother than others.

THE BALL & WOOD COMPANY, of New York, has just completed the installation of a steam plant in the new building of the Lawyers' Title Insurance Company, on Maiden lane, New York, and the attention of engineers is invited particularly to its method of building the foundation in this instance. This company has also furnished the additions for the steam plant for the Yonkers Railroad Company, and for the Morris County Electric Light Company, Morristown, N. J. Three of its tandem compound engines have also just been installed with the Flatbush Gas Company, Flatbush, L. I.

QUEEN & CO., INC., Philadelphia, Pa., report that the Siemens dynamometer is meeting with a largely increasing demand. It being the standard by which most alternating current ammeters are calibrated, the very rapid growth in the employment of alternating current apparatus accounts for a great part of this increase. Many users want them for transformer testing, and to measure the primary currents specially low ranges down to .03 ampere have been designed. For the secondary currents, instruments are made up to 500 amperes. They are also used very largely for calibrating direct current instruments, being equally accurate for alternating and direct currents.

THE OHIO BRASS COMPANY, Mansfield, Ohio, reports large orders on its material from the following roads since the 1st of June: Consolidated Street Railway Company, Toledo, Ohio; Columbus Street Railway Company, Columbus, Ohio; Marion Street Railway Company, Marion, Ohio; Calais Electric Street Railway Company, Calais, Me.; Dallas and Oak Cliff Electric Railway Company, Dallas, Tex.; South Covington and Cincinnati Railway Company, Covington, Ky.; Fort Wayne and Belle Isle Electric Railway, Detroit, Mich.; Tiffin and Interurban Street Railway Company, Tiffin, Ohio; Akron Street Railway Company, Akron, Ohio; Cleveland Electric Railway Company, Cleveland, Ohio; Omaha Street Railway Company, Omaha, Neb.; Middletown-Goshen Traction Company, Middletown, N. Y.; Montgomery Street Railway Company, Montgomery, Ala.; La Crosse City Railway Company, La Crosse, Wis.

MR. S. W. RUSHMORE, 126 Liberty street, New York, has met with encouraging success in his system of armature winding, having wound armatures for a number of the largest Edison and other stations throughout the country, including machines as large as 250 h. p. In addition to this special drum armature winding, Mr. Rushmore is making a specialty of every class of heavy central station repairs, and has fully equipped his factory, at the foot of Morris street, Jersey City, N. J., with the heaviest class of machine tools required for this work, and for the building of large low tension dynamos for copper refining and depositing. He also has a number of orders for overhauling and rebuilding generators, including an order for two stations that have been partly burned, comprising some 15 machines. Mr. Rushmore is about to place on the market a new series arc machine for street lighting, that is especially adapted to meet the requirements of long and rough service.

STERN & SILVERMAN, of Philadelphia, report business as very active. In the railway department they have contracts for the reconstruction of the Brigantine Transit Company's road, at Brigantine, N. J., seven miles in length, on trestle construction; at Altoona the Bellwood extension of the Logan Valley road for the Pennsylvania Railroad, eight miles in length; also the Roxborough Inclined Plane and Railway, six miles long, running from Philadelphia to Barren Hill. In the steam department they report a 600-h. p. boiler plant for the Roxborough road, and two 300-h. p. Ball & Wood compound condensing engines; one 10 inch by 11 inch direct connected Ball & Wood engine for Doorer's Hotel, Philadelphia; one 10 inch by 11 inch direct connected Ball & Wood engine for the Mann Building, Philadelphia, and one 8 inch by 10 inch engine for the boat Havana. In the lighting department they have contracts under way for the central station at Overbrook, Pa.; the lighting of the Episcopal Hospital, Philadelphia; electrical equipment of the river boat Havana, and an arc plant for the pleasure pavilions at Brigantine Beach, N. J.

MR. H. WARD LEONARD, 136 Liberty street, New York, the president of the Carpenter Enamel Rheostat Company, has quite recently had granted to him a very important patent upon electric heaters, after a contest of two years, and after two appeals in the Patent Office. His patent will issue on July 10, and is a fundamental patent of the greatest importance in electric heating, and is likely to mark an era of rapid extension of the application of electricity to all kinds of heated tools. It is a fact but little appreciated that almost every trade in existence necessarily uses certain tools which have to be heated, some of them to merely a low temperature, and others to an extremely high temperature, and in many trades there is a great demand for a tool which could be heated to a bright red heat, heretofore impossible, and work of this nature, such as hard soldering in the manufacture of silver and other metal wares, has heretofore necessarily been done through the agency of a blowpipe. By Mr. Leonard's invention he expects to be able to economically heat not only all such tools as are at present in use, but also to supply an entirely new line of tools to replace the application of blowpipes, gas flames, charcoal stoves, etc., in all the various trades.

THE CARPENTER ENAMEL RHEOSTAT COMPANY, 136 Liberty street, New York, has quite recently moved into its new factory building at Hoboken, N. J., and is now in a position to supply the rapidly increasing demand for goods of its manufacture in its various lines. The growth of this company's business is surprising even to those who appreciated the merits of its rheostat when it was first offered to the public. These rheostats were first placed upon the market only two years ago, but on account of the sustained effort of the Carpenter company to maintain the highest standard of excellence, and on account of its liberal policy, giving to its customers the benefit of all reductions in cost, made possible by numerous improvements in the business, they have practically become the standard throughout the United States, and are to-day used by almost all manufacturers of dynamos and all of the best informed contractors. The Carpenter company has developed a very fine line of all kinds of rheostat switches for all possible uses. One of the most important of its recent pieces of apparatus is its new automatic switch, the demand for which shows the great need of a simple and reliable switch of this nature at a moderate cost.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden Carbon porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MANUFACTURING COMPANY, 2140 DeKalb street, St. Louis, Mo.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED JUNE 12, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

521,163. CONTACT TROLLEY; R. W. Hawkesworth, East Orange, N. J. Application filed March 15, 1894. The combination with the standard of a railway car, of a trolley bar consisting of two arms connected by an intermediate spring plate or bar.

521,168. THERMO-ELECTRIC BATTERY; E. W. Jungner, Skara, Sweden. Application filed March 9, 1894. This comprises plates composed of two strips of different metals, the elements connected in series, the strips of one kind of metal alternating with those of the other kind, and having alternate joints insulated by means of a non-conductor of heat.

521,170. PRINTING TELEGRAPH; O. L. Kleber, Pittsburgh, Pa. Application filed April 13, 1893. A telegraph instrument in combination with a rock shaft, a projecting finger attached to the shaft, a spring for drawing the same in one direction, and a revoluble cam that will at proper intervals force the shaft and finger back to its original position or starting point.

521,183. POLICE SIGNAL TELEGRAPH SYSTEM; C. A. Rolfe, Chicago, Ill. Application filed Oct. 22, 1892. This comprises a signal transmitting instrument, a lever for operating the same, and a setting device adapted to set the signal transmitting mechanism for a special signal and comprising a vibratory lever subject to and operated by the first lever.

521,188. MAGNETO TELEPHONE; A. Stromberg and A. Carlson, Chicago, Ill. This comprises a cap, a diaphragm resting against the under side thereof, a threaded ring adapted to be screwed within the cap against the diaphragm, and a casing provided with threads adapted to engage threads upon the cap.

521,220. ELECTRIC TELEPHONE; W. L. Richards, Malden, Mass. Application filed Dec. 14, 1893. This comprises a hollow block of slate forming the casing and side walls of the resistance containing chamber, the block containing a fixed electrode at the rear of the chamber, a vibratory electrode mounted and adapted to vibrate within the front opening of the chamber, and finely divided conducting material placed within the chamber and between the electrodes.

521,238. BOND FOR ELECTRICAL CONDUCTORS; J. Herr, Philadelphia, Pa. Application filed May 11, 1894. This comprises a tapered hole in the conductor, a split bolt having a head and conical shank externally threaded and a hole passing longitudinally through said head and shank, a nut adapted to be screwed up on said conical shank of the bolt, and a wire adapted to enter and be grasped by the sides of the hole in the bolt.

521,239. BURGLAR ALARM; C. R. Hoopes, Ogontz, Pa. Application filed April 5, 1894. This comprises a movable door, a bolt to limit the movement thereof provided with a circuit closing device, and means to normally hold the movable bolt in a fixed position to maintain the circuit open.

521,260. ELECTRIC BATTERY; F. Dubero and P. Mohrdieck, San Francisco, Cal. Application filed Jan. 15, 1894. This comprises an exterior tank containing an excitant, a positive element submerged therein, a shaft extending across the containing tank and a cylinder composed of perforated sides and rim, and adapted to contain a pulverized element, which acts as a negative in the battery.

521,269. CORE CONTRACTING SOLENOID; W. R. Michl, Wetteron-the-Ruhr, Germany. Application filed April 26, 1892. A solenoid composed of convolutions of a single insulated wire, the number whereof decreases in the consecutive sectional portions of the solenoid from one end to the middle and then increases again toward the other end.

521,274. TELEPHONE SWITCH; J. B. Smith, Manchester, N. H. Application filed April 27, 1894. This consists of a pair of slotted pivoted rocker arms having secured thereto respective switch levers combined with electrodes, and a detachable hand telephone. (See illustration.)

521,303. BUSY TEST FOR MULTIPLE SWITCHBOARDS; J. A. Wotton, Atlanta, Ga. Application filed April 20, 1894. A headphone circuit, a circuit-maker included therein, a test plug, a circuit therefor, a galvanometer included therein, the needle of the galvanometer being connected operatively with the circuit-maker.

521,311. TROLLEY WIRE FENDER; T. E. Gressle, Indianapolis, Ind. Application filed Oct. 28, 1893. The combination with a trolley support and trolley, of directing bars adapted to be elevated by movement upon the axis of the trolley, and a double free ended spring attached to one of the bars.

521,322. INCANDESCENT LAMP SOCKET; L. R. Peck, St. John's, Mich. Application filed Feb. 23, 1894. This comprises an upper disc to which the conductors are secured, contacts thereon, a second disc carrying the lamp contacts, a switch, and posts forming a part of the circuit, detachably engaging with the contacts on the upper disc.

521,325. TELEPHONE TRANSMITTER; J. B. Smith, Manchester, N. H. Application filed April 27, 1894. A multiple electrode made in sections, the alternate insulated layers of which are connected together combined with a cup containing finely divided conducting material supported on a diaphragm and adapted to vibrate in unison with the latter.

521,326. CONDUIT SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; H. Alexander, New York, N. Y. Application filed Jan. 9, 1894. A current collector of channel form with flaring ends and interior contact springs.

521,362. ELECTRIC ARC LIGHT FOR MAGIC LANTERNS; C. Beseler, Jersey City, N. J. Application filed March 16, 1894. A light for magic lanterns provided with a carbon carrier, comprising a tube supported on a rack, a rod fitted to slide in the tube and provided with a clamp for the carbon, and a screw rod turning in the tube and screwing in the rod.

521,394. APPARATUS FOR MEASURING AND RECORDING ELECTRIC CURRENTS; W. Thomson, Glasgow, Scotland. Application filed Feb. 8, 1893. The combination of a fixed solenoid carrying a scale, a movable magnet carrying an indicator and a yielding support for holding the magnet normally in elevation and in proper relation to be attracted by the solenoid.

521,396. ELECTRIC CLOCK WINDING MECHANISM; A. E. Vidal and G. Hervieu, London, England. Application filed Sept. 30, 1892. The combination with an arbor of a ratchet wheel mounted thereon, connected with a source of power, a solenoid core adapted to drive the ratchet wheel and having the same pitch as the first ratchet wheel, a contact piece actuated by the last ratchet wheel, a solenoid and an electric circuit including the contact maker and solenoid.

521,412. TRACK CIRCUIT; L. F. Johnson, Poughkeepsie, N. Y. Application filed April 7, 1894. This comprises a series of protected sections composed of two opposite lines of rails, intermediate sections composed of rails of high resistance, a battery and relay connected to each protected section and a connection between the opposite lines of rails at the end of each protected section.

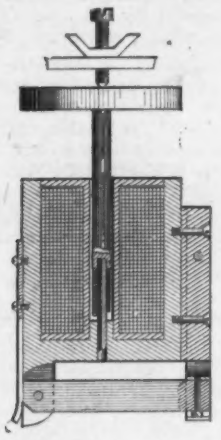
521,422. TELEPHONE CALL RECORDER; W. F. Smith, San Francisco, Cal. Application filed May 5, 1893. This comprises a type wheel, setting wheel, setting lever, brake lever, coil springs, and a polarized relay having separately acting armatures and rods actuated by the armatures.

521,423. AUTOMATIC ELECTROMAGNETIC CUT-OUT; L. T. Stanley, Brooklyn, N. Y. Application filed July 18, 1893. This comprises an electromagnetic cut-out for automatically interrupting a circuit upon any abnormal increase in the current flowing therein, and a fusible conductor in shunt to the terminals of the cut-out. (See illustration.)

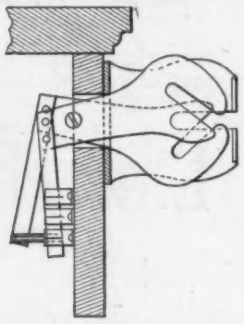
521,434. DUPLEX ELECTRIC ARC LAMP; G. F. Edens and J. B. Brewer, Xenia, Ohio. Application filed March 31, 1894. This comprises feed rods, a trip lever for each adapted to hold same in a raised position and having a portion thereof arranged in the path of movement of the adjacent feeding rod, the feed-rods carrying means for engaging a portion of the trip levers for releasing the adjacent feed-rods, whereby the arc may be completed in either set of carbons by the downward movement of the adjacent feeding rod.

521,435. AUTOMATIC ELECTRIC SIGNAL LAMP; J. R. Farmer, St. Louis, Mo. Application filed April 9, 1894. This comprises a hood containing electromagnets within a rectangular frame, a sliding armature connected by a plate to a crank, a suspended lantern and a shunt circuit connection.

521,436. SYSTEM OF ELECTRICAL DISTRIBUTION; T. J. Fay, New York, N. Y. Application filed Feb. 15, 1894. In a multiple series system of distribution, the combination of a main generating station, two main conductors leading therefrom, an intermediate or compensating conductor between the groups or sets of translating devices, two generators connected in series with each other



NO. 521,423.—AUTOMATIC ELECTROMAGNETIC CUT-OUT.



NO. 521,274.—TELEPHONE SWITCH.

and normally tending to augment the supply of current to the mains, but so connected as to supply extra current to either group of translating devices which require it in order to establish a balance between the two groups, and an electric motor driving both generators and supplied with current from the mains. (See illustration.)

U. S. PATENTS ISSUED JUNE 19, 1894.

521,455. ELECTRIC RAILWAY SIGNAL; C. R. Alsop, Middletown, Conn. Application filed Oct. 12, 1893. The combination with a rail in electrical circuit with a signaling device and a battery, of a laterally movable spring actuated contact bar, in the same circuit with the rail and normally spaced from the inner side of the rail, whereby the circuit is completed through the rail and contact bar by the interposition of the metallic flange of a car wheel.

521,461. COMBINED ANNUNCIATOR AND SPRING-JACK; H. M. Fisk, Chicago, Ill. Application filed May 14, 1894. The combination in a switchboard of a jack, and a drop adapted to swing in front of it, an electromagnet located in the rear of the jack and an armature having a connection for catching and supporting the drop when it is raised by the entrance of the connecting plug.

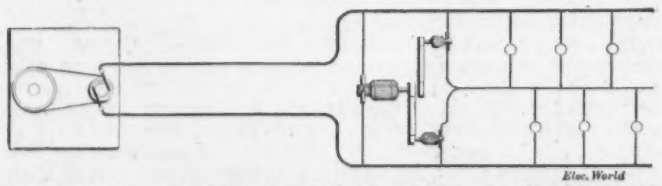
521,514. TELEPHONE SWITCH; A. Stromberg and A. Carlson, Chicago, Ill. Application filed Jan. 26, 1894. This comprises a hand telephone, movable contact element, a telephone line, two contact anvils, signaling apparatus and a telephone set. (See illustration.)

521,550. PRINTING TELEGRAPH; E. Pope, Quebec, Can. Application filed June 20, 1890. The combination with a magnet whose core serves as an anvil for the stroke of a printing lever, of a casing having slots through which the usual printing and paper rolls pass.

521,553. ELECTRIC RAILWAY SIGNAL; B. Samuels, St. Louis, Mo. Application filed July 26, 1893. In a train signaling mechanism, the combination with a signal carried by the train, and circuit closing devices between the train and the station, of a drop arm, spring, magnet and catch.

521,594. ELECTRIC BELT; E. M. Miles, Chicago, Ill. Application filed July 1, 1893. In a battery for electric belts, cells, in combination with a hinge device connecting adjacent cells and provided with an eye formed in the hinge itself for making connections.

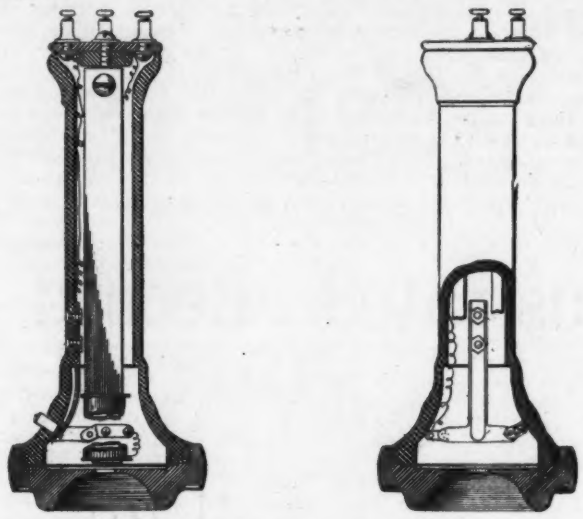
521,602. TROLLEY POLE CATCHER; O. G. Gates, Jr. Application filed March 12, 1894. The means for resetting a tripped trolley pole, comprising the combination with the spring bearing bar, of slotted links through which the bar passes, and a lever to which the links are connected.



NO. 521,436.—SYSTEM OF ELECTRICAL DISTRIBUTION.

521,651. ELECTRIC RAILWAY CAR MOTOR; J. C. Henry, Westfield, N. J. Application filed Aug. 25, 1893. This comprises a motor having a shunt-wound multipolar field magnet, a rotating pole changer in the field circuit, a gear wheel on the armature shaft, and a pinion on the shaft of the pole changer.

521,666. ALTERNATING CURRENT REGULATOR; O. Offrell, Middletown, Conn. Application filed Dec. 12, 1892. This comprises two opposing electromagnets, a core without a coil pivoted between the common pole pieces of the magnets and adapted to be turned more or less transversely to the lines of force joining said poles.



NO. 521,514.—TELEPHONE SWITCH.

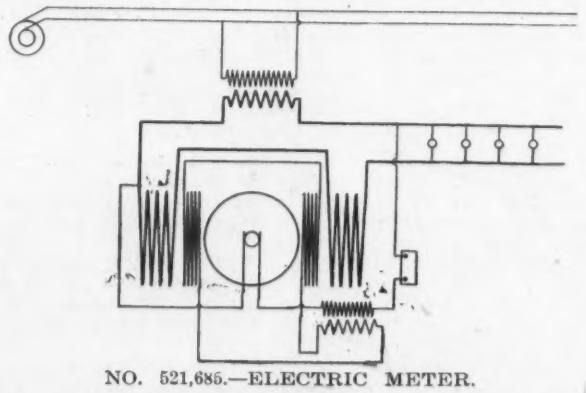
521,671. ARMATURE FOR DYNAMO ELECTRIC MACHINES; E. W. Rice, Jr., Schenectady, N. Y. Application filed April 19, 1894. An armature spider composed of a ring of diamagnetic material, provided with projecting arms having dovetailed ends and a lug projecting from each side of the arm adapted to engage with devices for keeping in place the core discs.

521,684. METER FOR RECORDING MEASUREMENTS OF ELECTRIC POWER; E. Thomson, Swampscott, Mass. Application filed Jan. 31, 1894. This comprises field magnet coils connected across the outer mains and disposed in sets, some of the coils of each set being upon opposite sides of the armature, an armature in shunt to the mains and a resistance in series with such armature.

521,685. ELECTRIC METER; E. Thomson, Swapscott, Mass. Application filed Feb. 21, 1894. In an electric meter and in combination, a coil in series with the mains, an armature in shunt to such mains, and a starting coil supplied with current by transformation from the armature circuit. (See illustration.)

521,721. ELECTRIC LAMP FOR BICYCLES; George Mayr, Brooklyn, N. Y. Application filed Nov. 7, 1893. In combination with a dynamo electric generator, composed in part of a gearing frame piece and a horizontal armature shaft carrying a pinion, a train of gearing machinery, disposed in the gearing frame piece, the initial driver thereof being carried by a shaft having a sprocket wheel mounted thereon, and the final driver thereof being adapted to mesh at all times with the pinion on the armature shaft.

521,711. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; Thomas Harris, Detroit, Mich. Application filed April 23, 1893. In an electric railway system, the combination with a continuous power line, of a working conductor composed of sections normally disconnected from the power line, a switch line and a return switch line extending along the working conductor from a stationary source of electricity, and electromagnet for each section of the working conductor, the armature of which is adapted to connect the section with the power line and with the switch line, two energizing circuits for each magnet, one connecting the sections of the working conductor with the return switch line through a normally open and normally closed break controlled by the next



NO. 521,685.—ELECTRIC METER.

adjacent magnets, respectively, and the other connecting the two switch lines through the said normally closed break of the other circuit, and a normally open break controlled by the magnet itself, and a contact on the car adapted to connect two adjacent sections of the working conductor.

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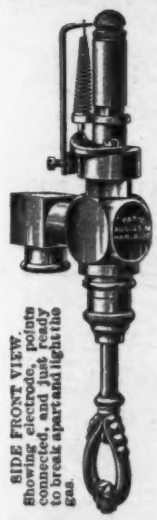

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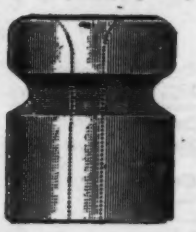

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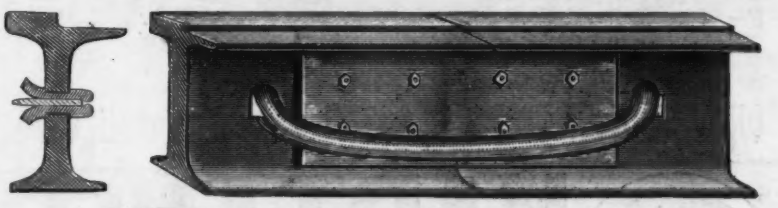

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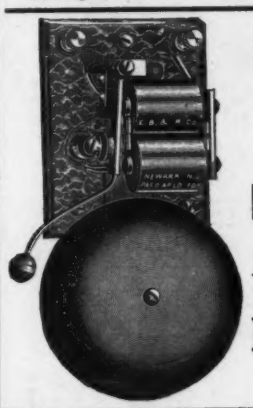

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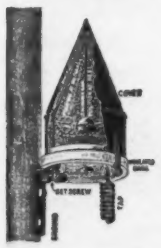

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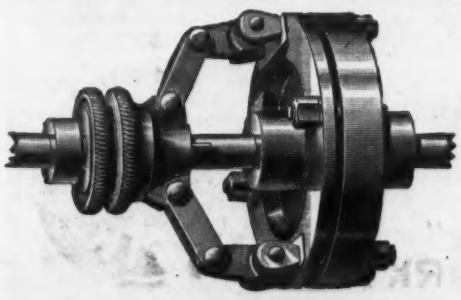

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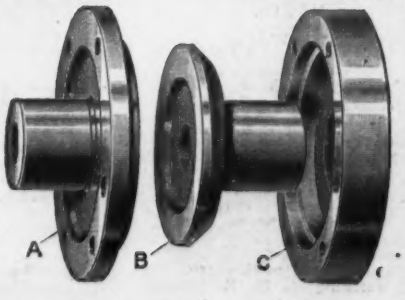

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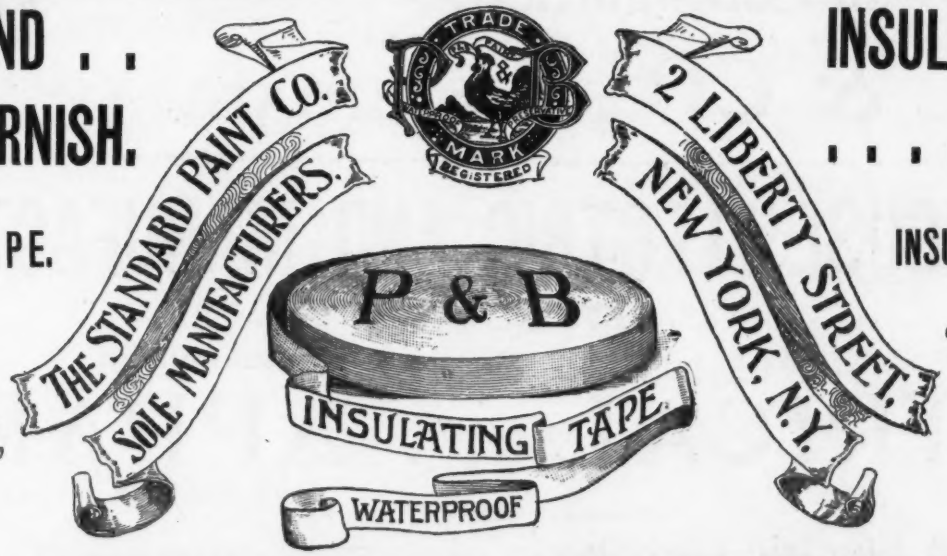

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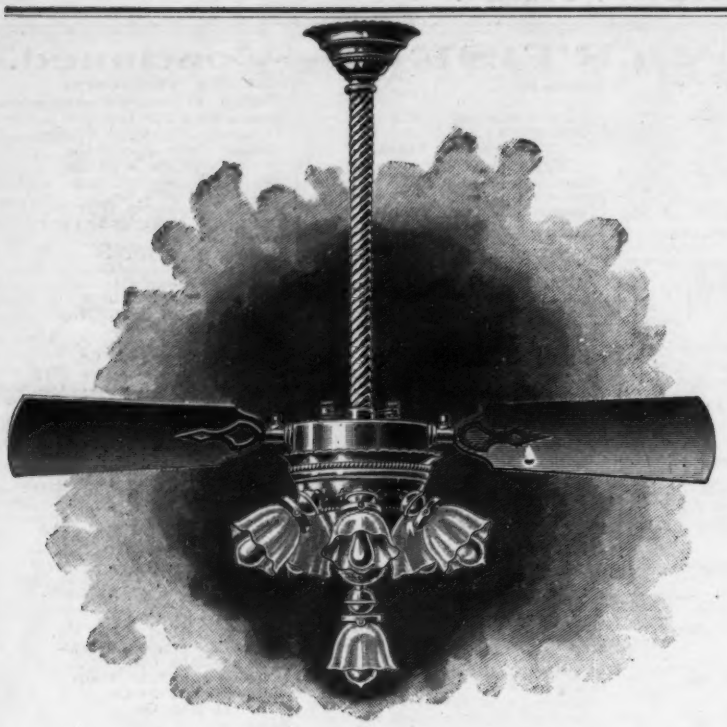

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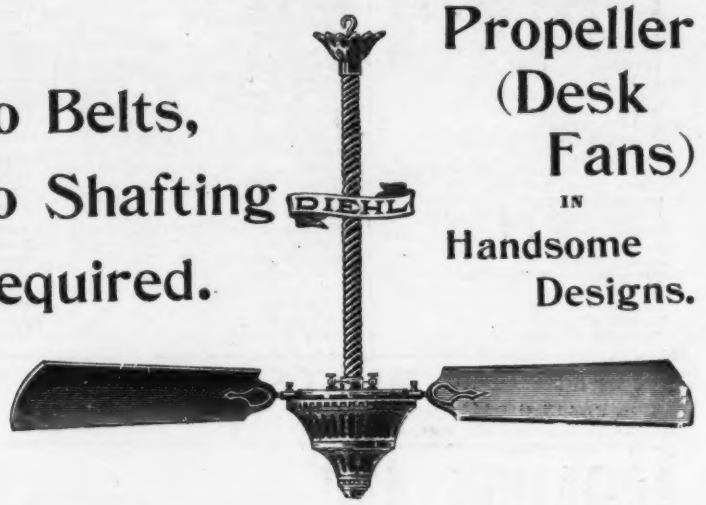

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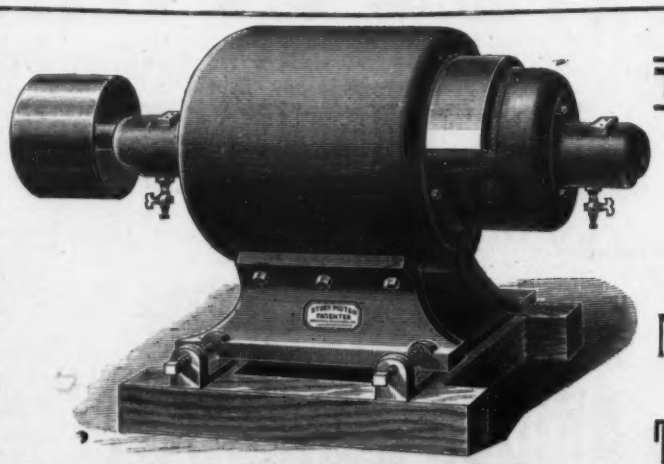

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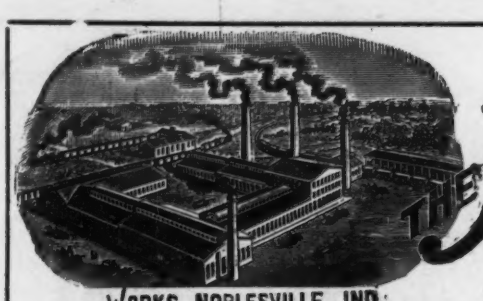

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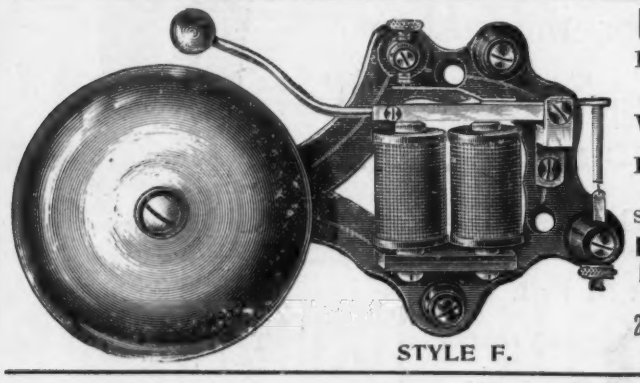

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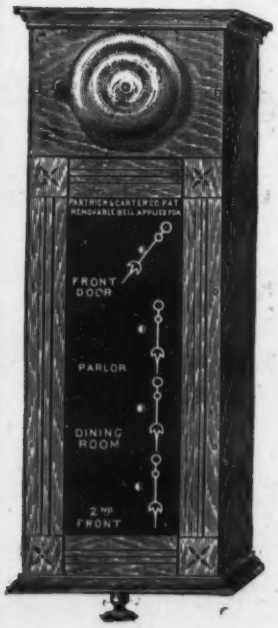

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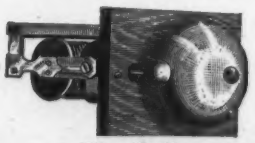

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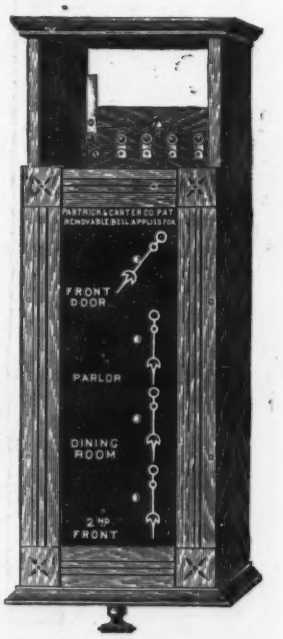

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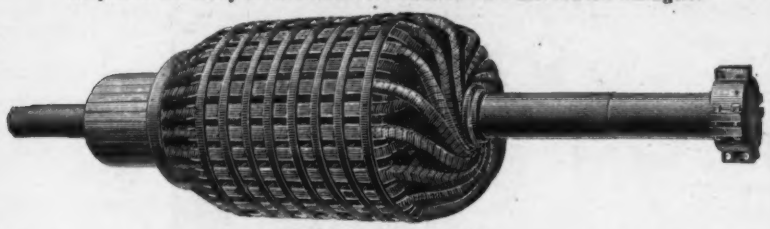

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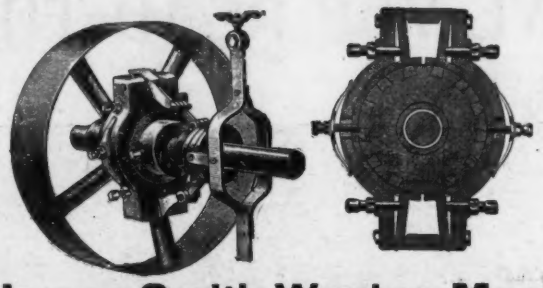

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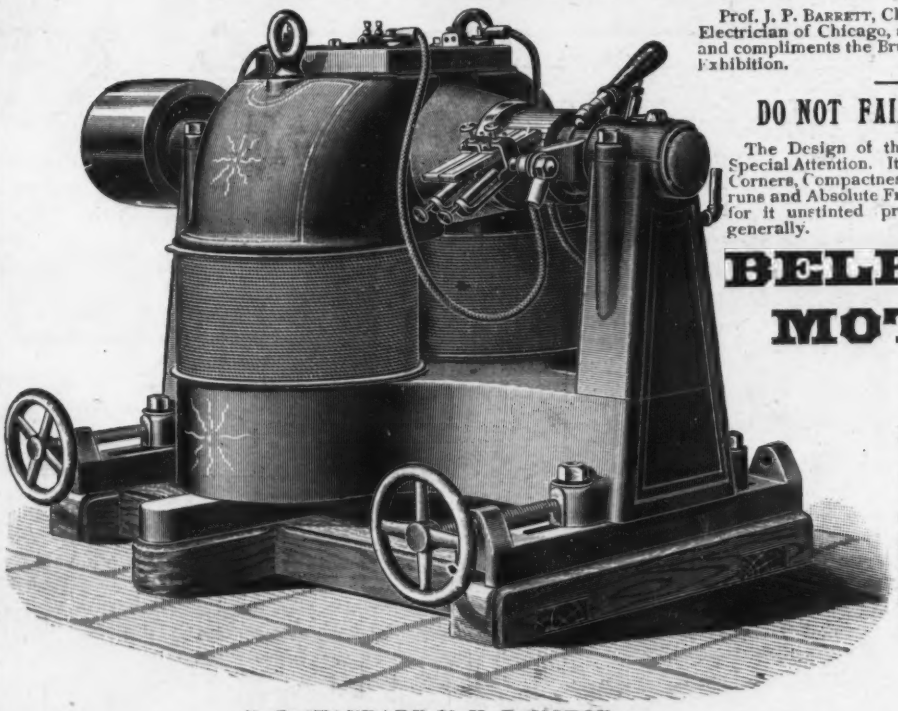

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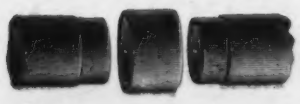

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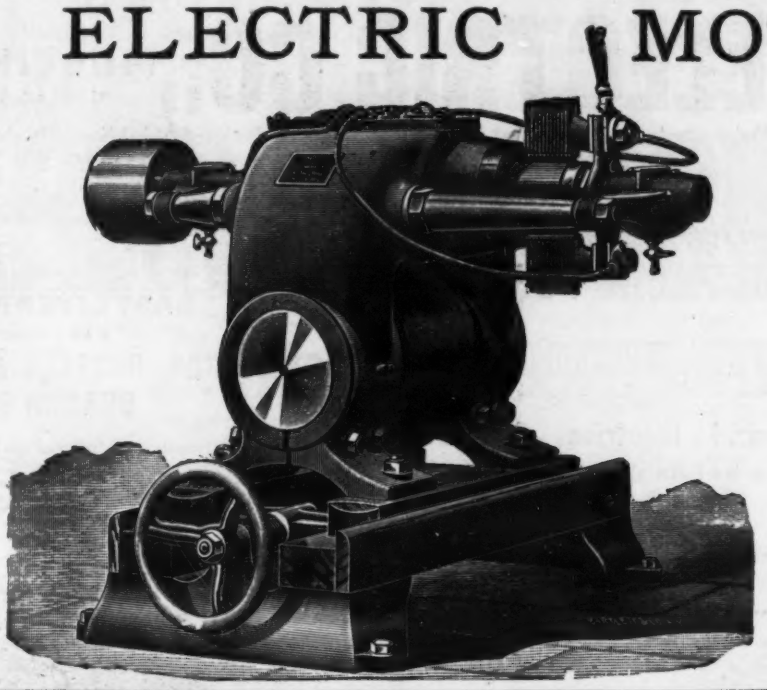

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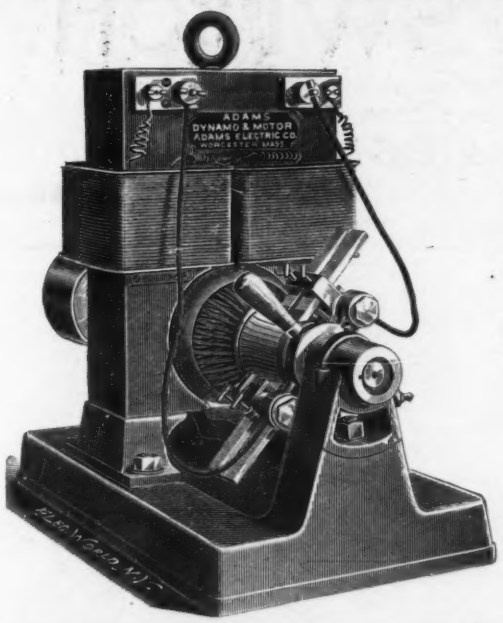

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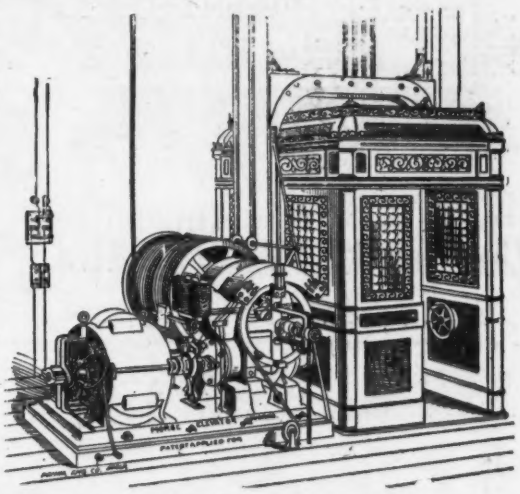

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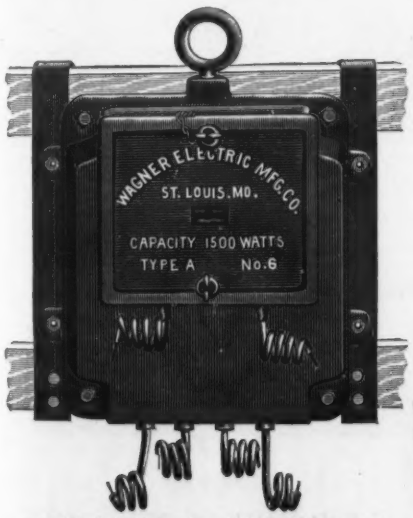

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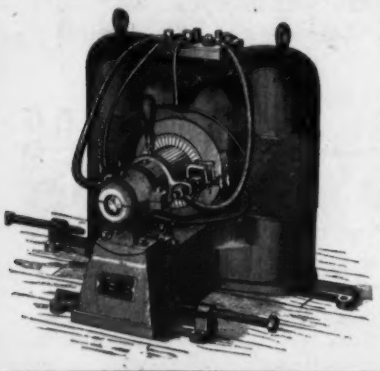

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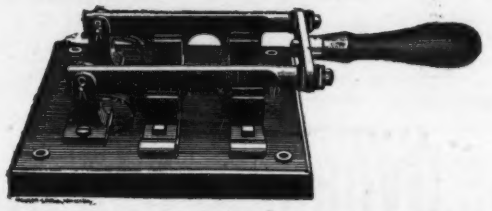

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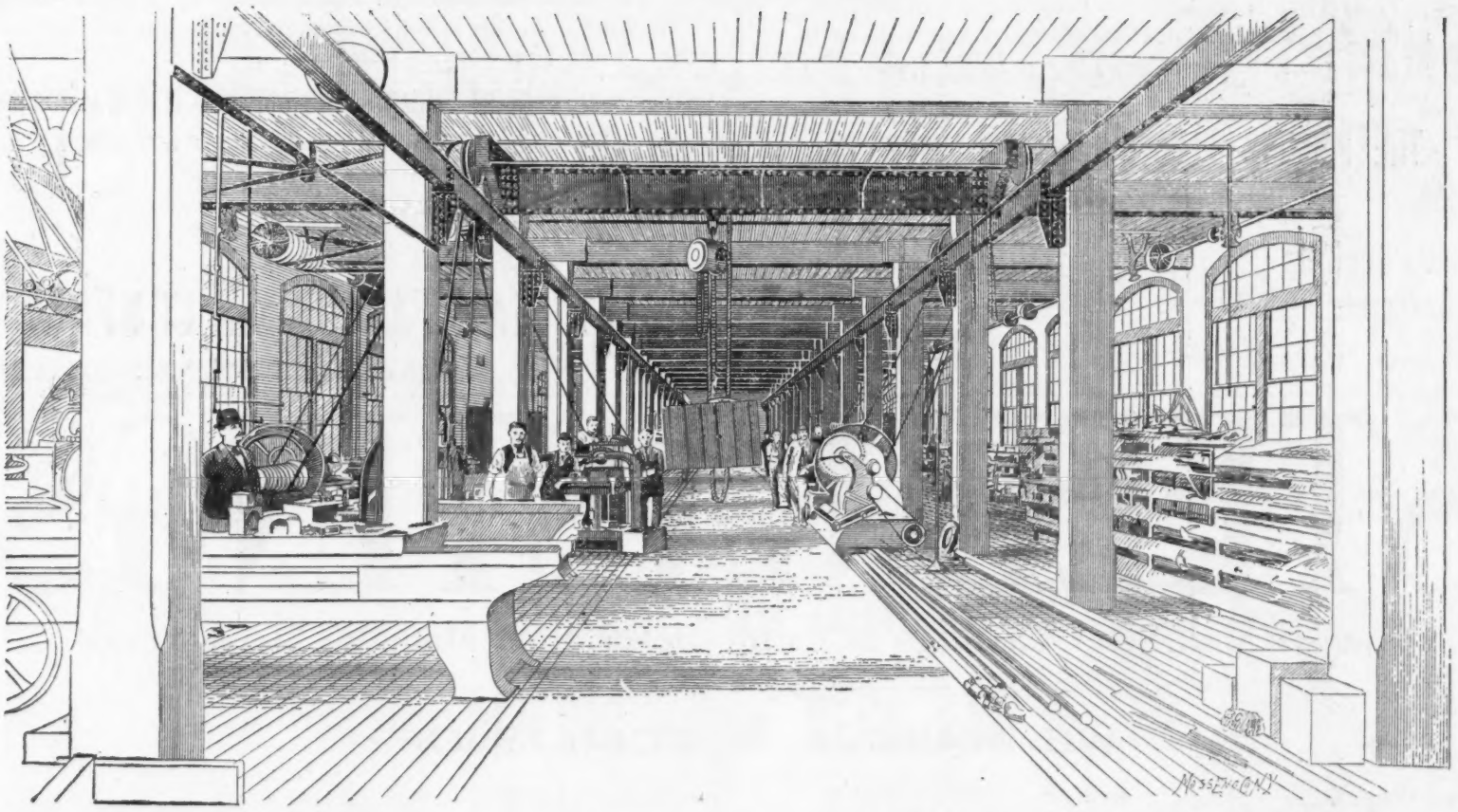

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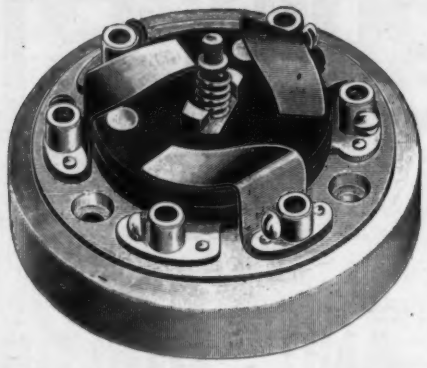
FOR  THE

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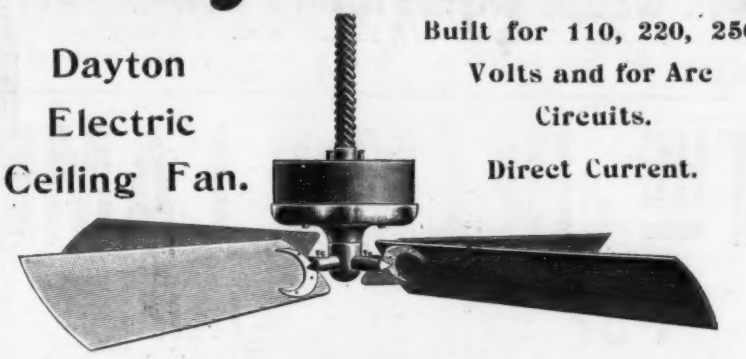

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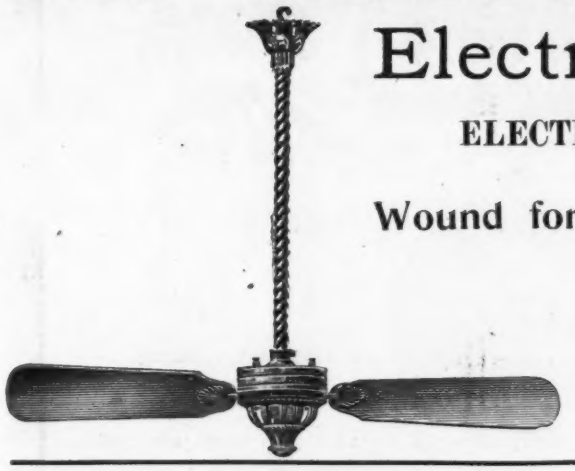

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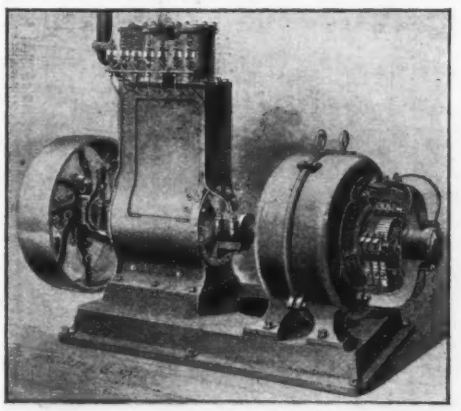

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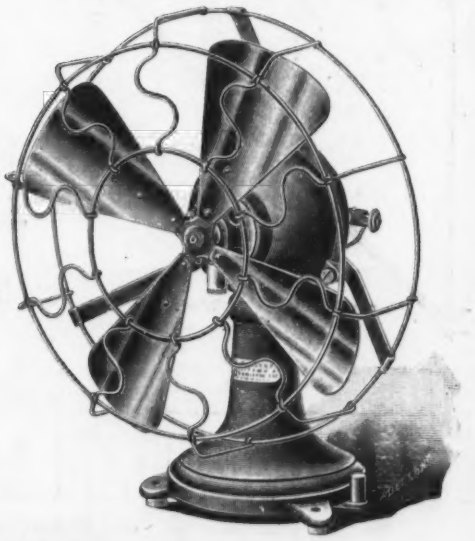

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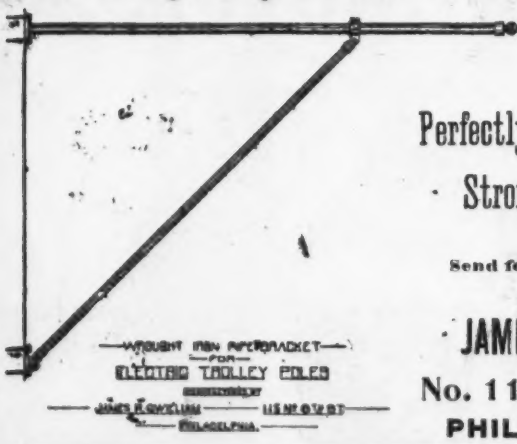

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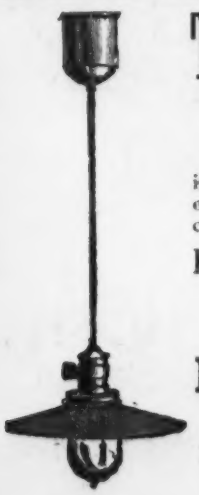

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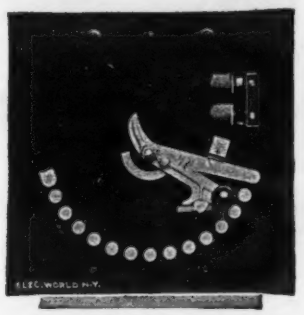
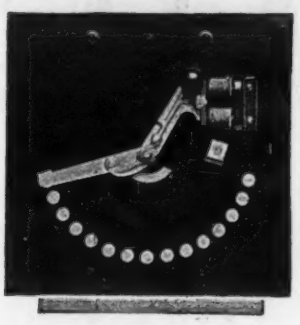


MOTOR STOPPED.



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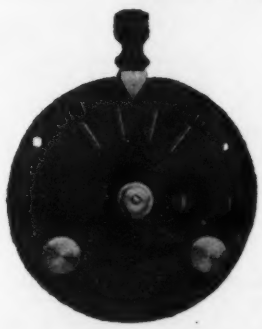

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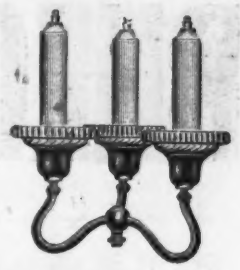

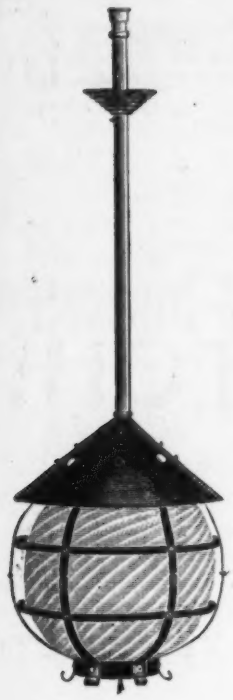

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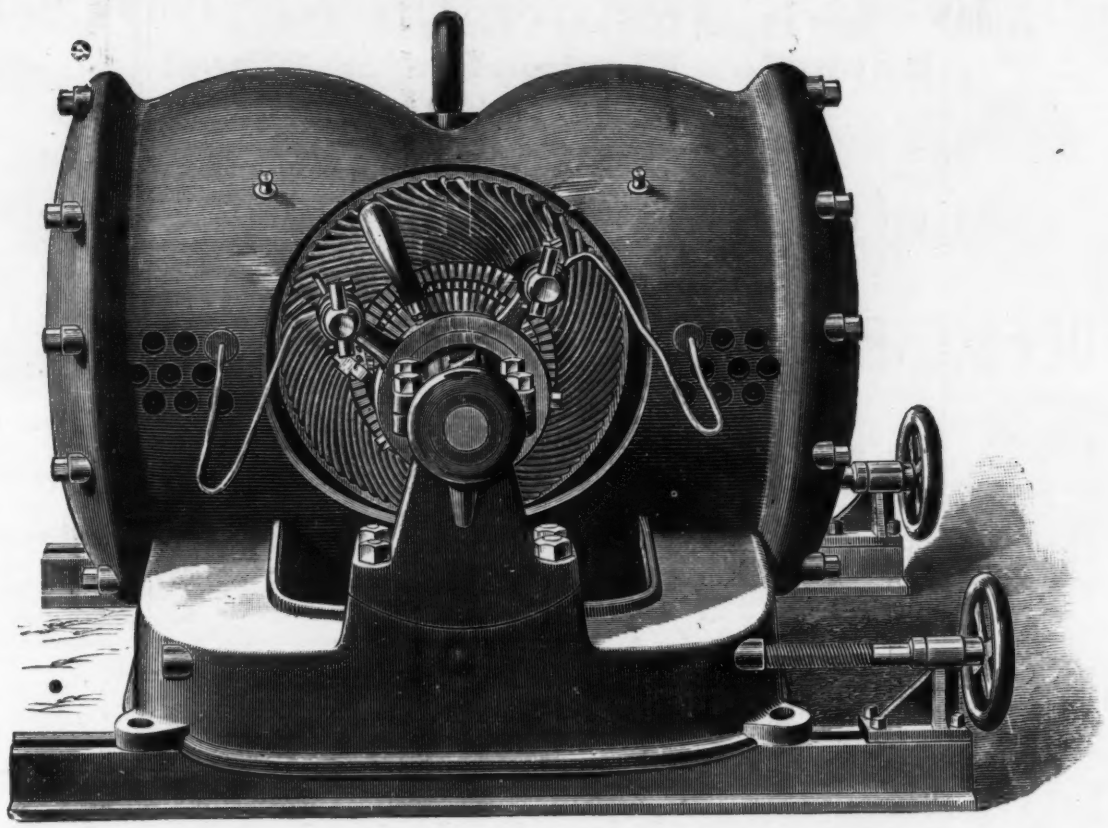

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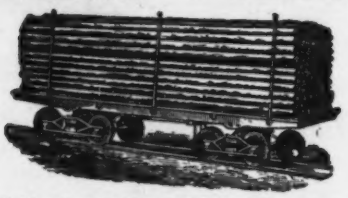

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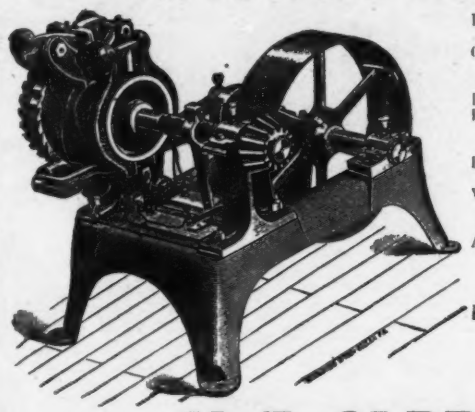

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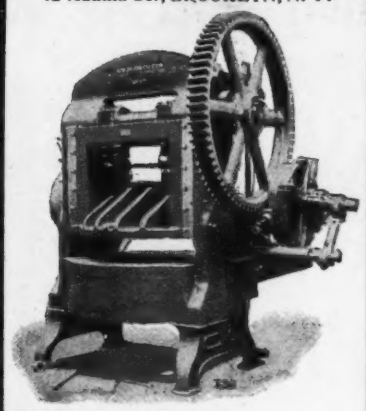

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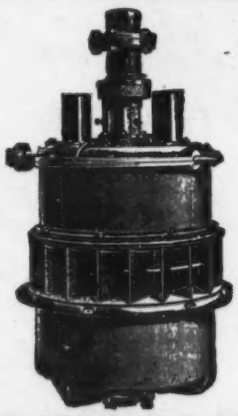

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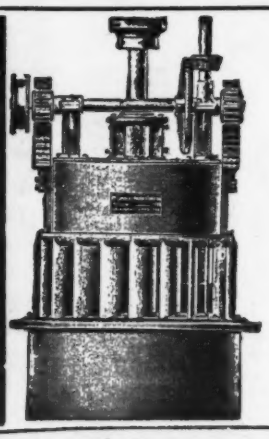

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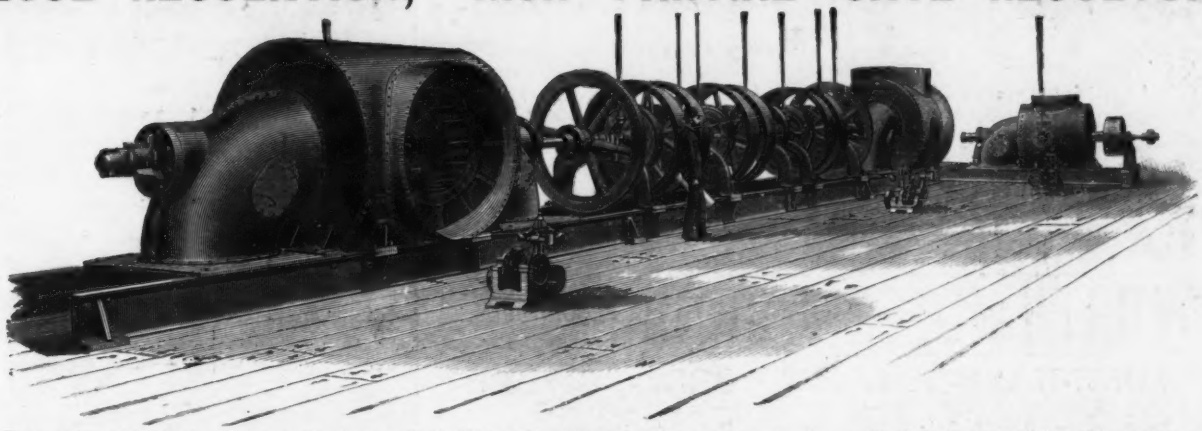

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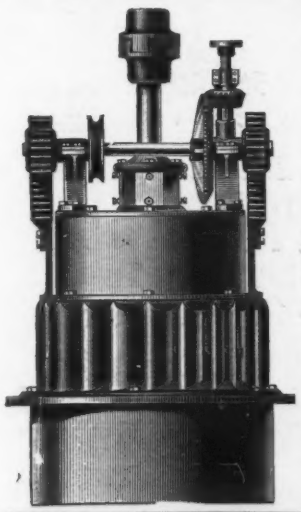

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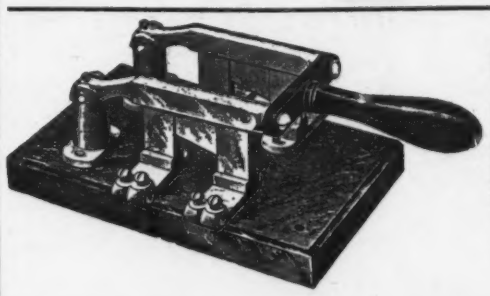

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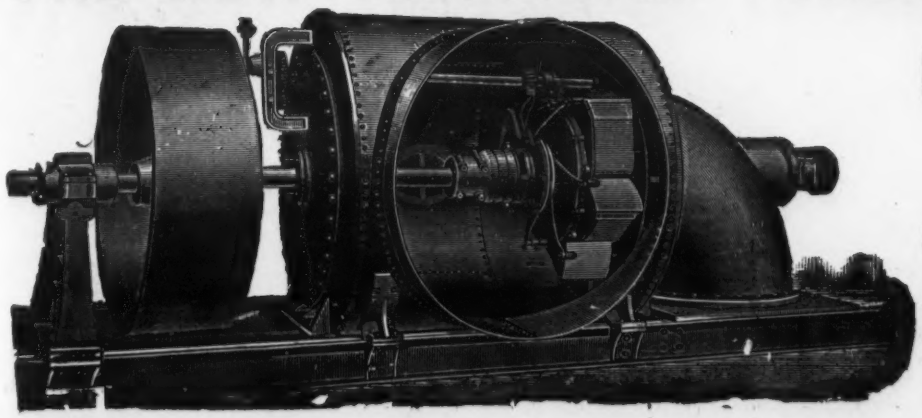

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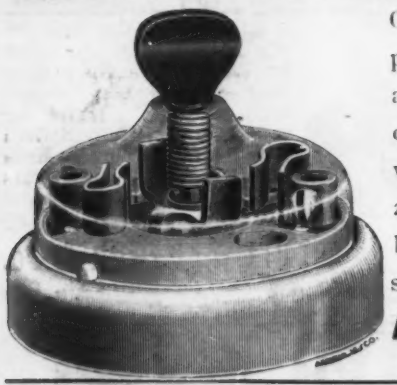

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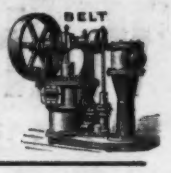

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THE ELECTRICAL WORLD

AN ILLUSTRATED WEEKLY REVIEW OF CURRENT PROGRESS IN ELECTRICITY AND ITS PRACTICAL APPLICATIONS

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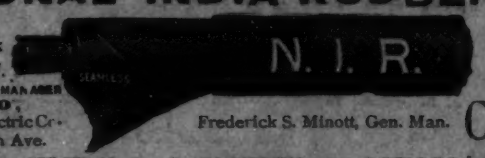

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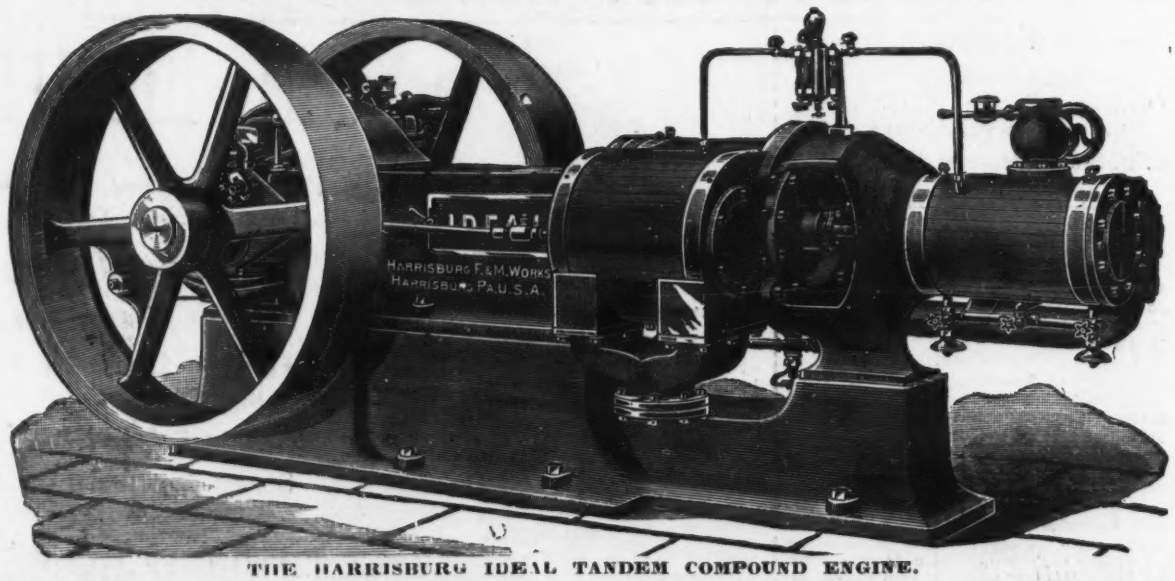

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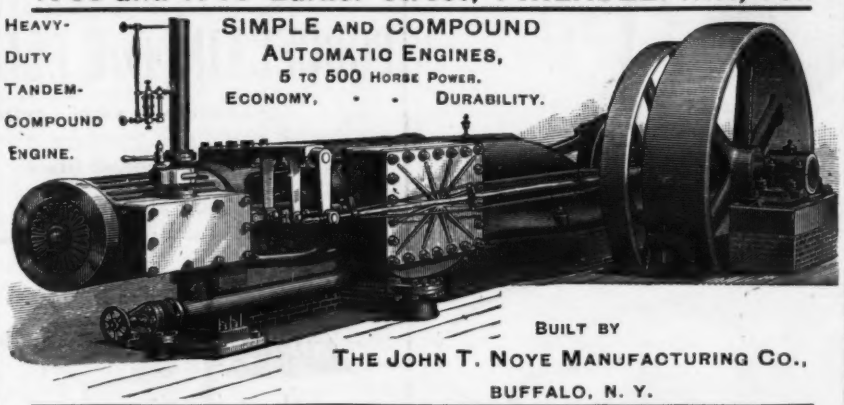

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PROPOSALS.

PROPOSALS FOR ELECTRIC WIRE.—Office of Building for Library of Congress, 145 East Capitol street, Washington, D. C., June 22, 1894.—Sealed proposals will be received at this office until 2 p. m. on Friday, the 6th day of July, 1894, and opened immediately thereafter in presence of bidders, for furnishing and delivering at the Building for Library of Congress, in this city, about 90,000 feet of rubber-covered electric wire. Specifications, general conditions and instructions and blank forms of proposal may be obtained on application to this office. BERNARD R. GREEN,
Superintendent and Engineer.

Electric Lighting.

SEALED PROPOSALS will be received by the undersigned until 4 o'clock p. m. of Thursday, the 12th day of July next, for the installation of an electric lighting plant for the City of Kalamazoo. Copies of the specifications for the same can be obtained by bidders from me. The City reserves the right to reject any or all bids. CHAUNCEY STRONG,
City Clerk,
Kalamazoo, Mich.

TOWNSHIP OF KEARNEY, N. J.

PROPOSALS FOR ELECTRIC LIGHTING.

Sealed proposals will be received by the Board of Township Committee of the Township of Kearney, Hudson County, N. J., for lighting the streets of said Township for a term of five years with electric arc lights.

Bidders will estimate separately on lights of 1,200 and 2,000 candle power.

There will be from 80 to 125 lights required.

Bids will be received up to 9 o'clock p. m. of Tuesday, July 10, 1894, at the Township Hall in said Township, and must be indorsed "Proposal for Electric Lights."

The Township Committee reserves the right to reject any or all bids as may be deemed for the best interest of the Township.

By order of the Board of Township Committee. GABRIEL B. REID,
Township Clerk.

Dated, Kearney, N. J., June 12, 1894.

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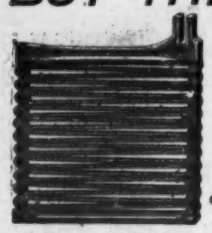

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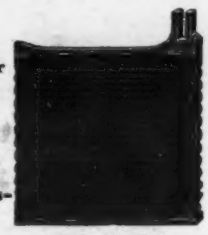

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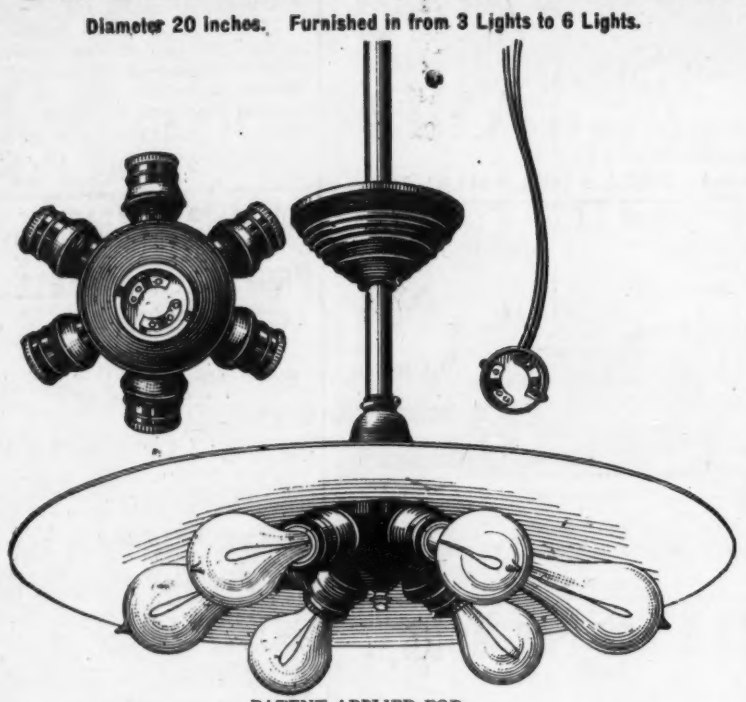

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Porcelain Shade removed without disconnecting wires.

Can be attached close to ceiling.

Illustration shows complete; also separated showing contact.

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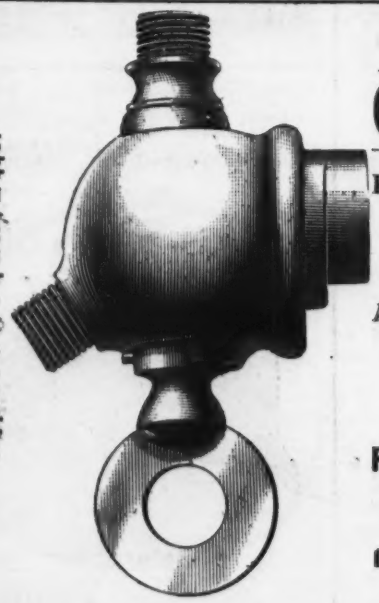

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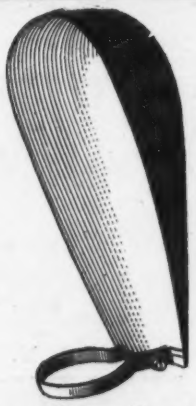

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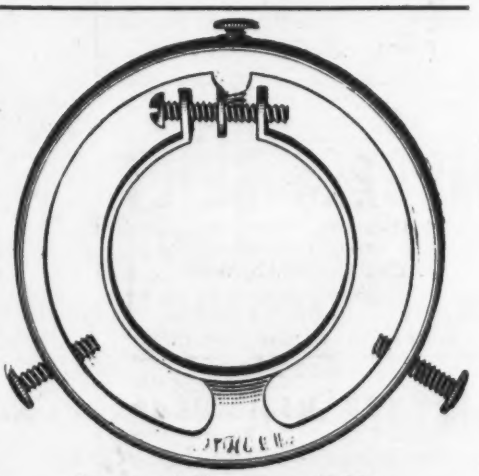

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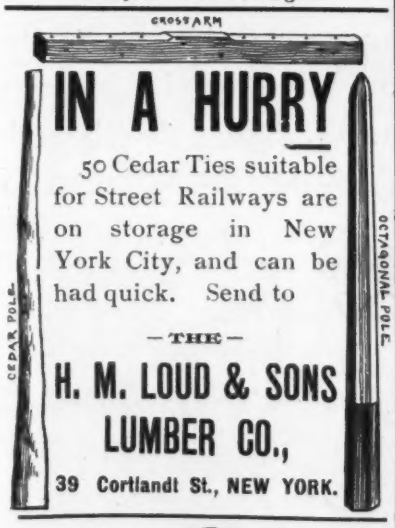

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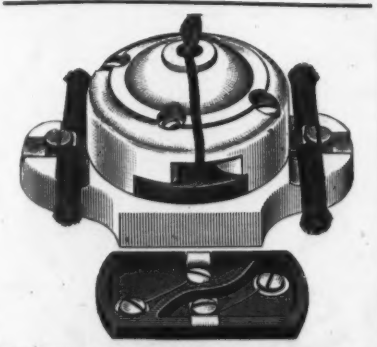

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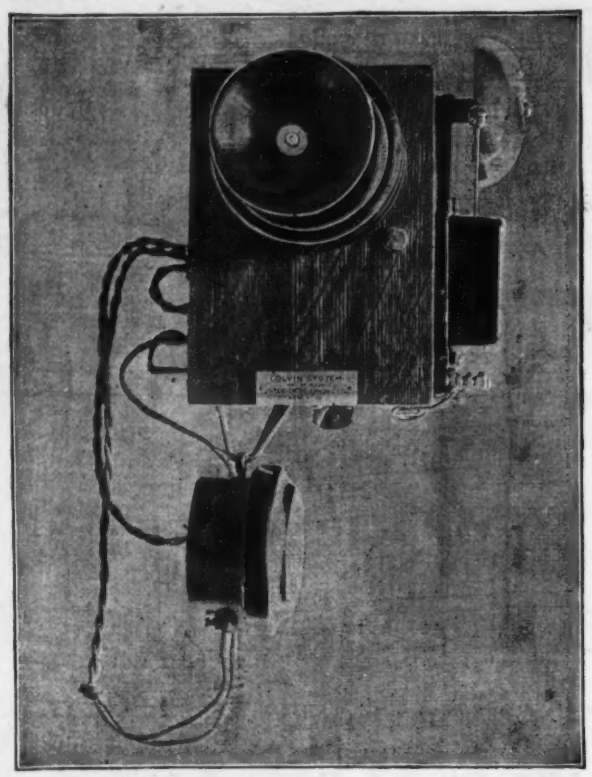

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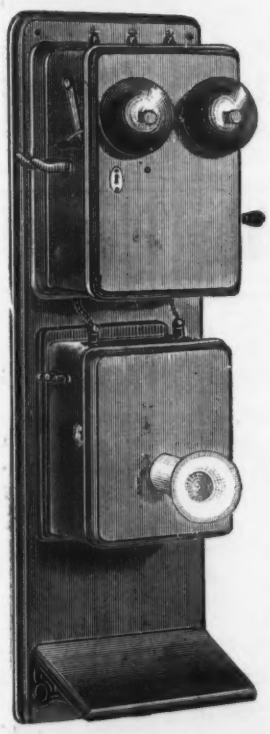

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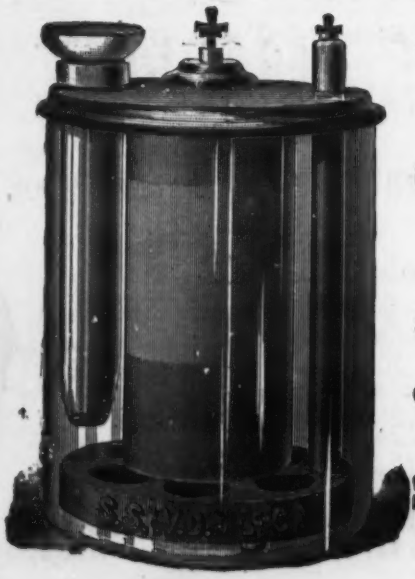

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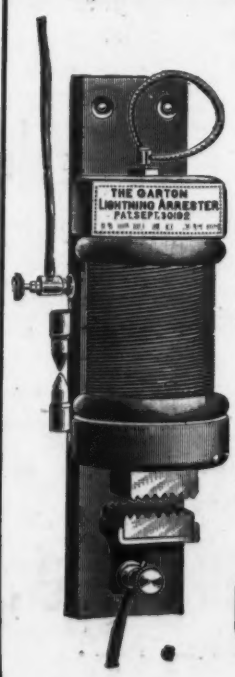

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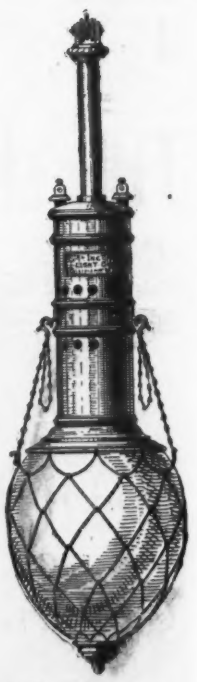

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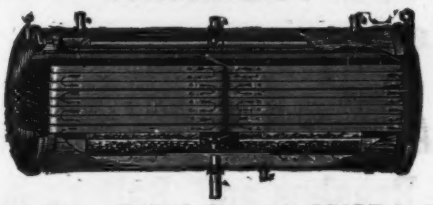

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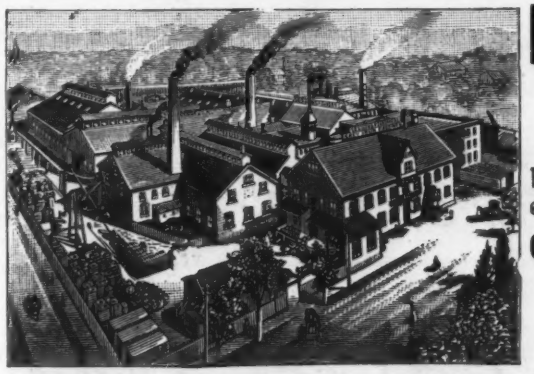

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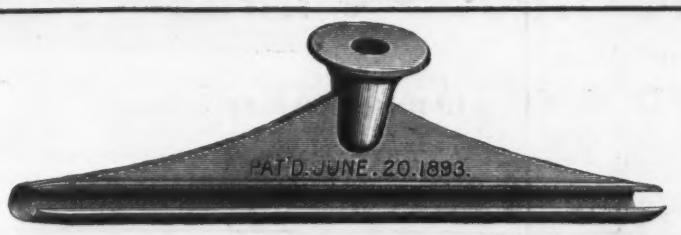

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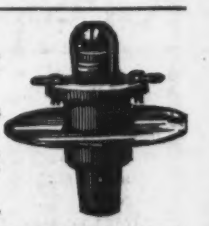

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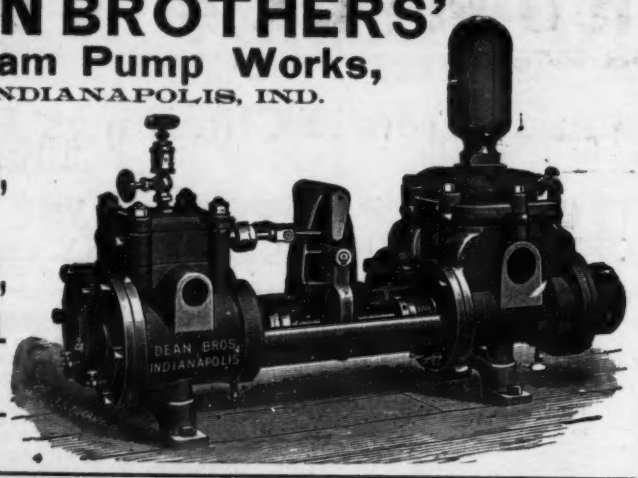

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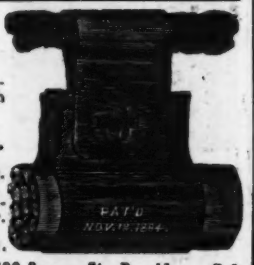

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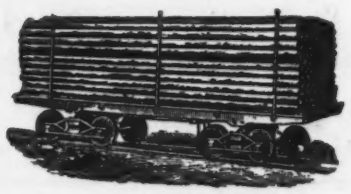

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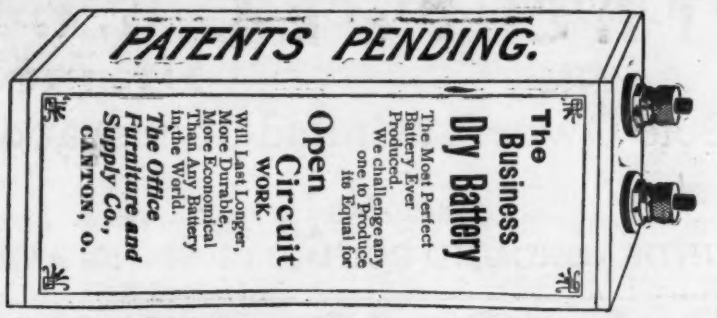
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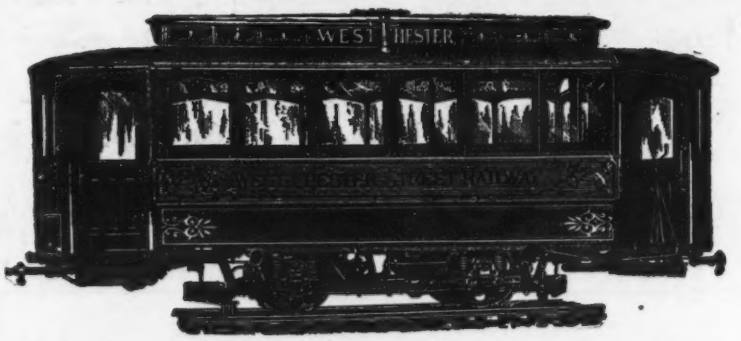

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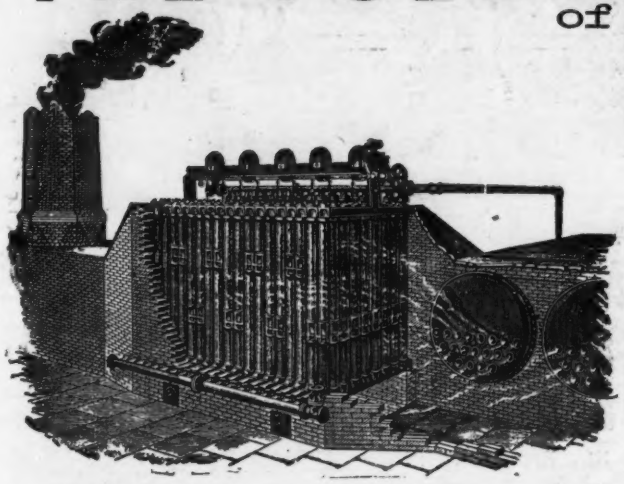

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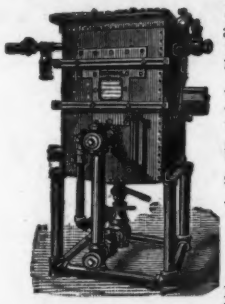

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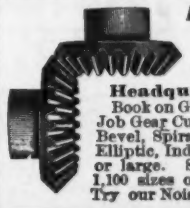

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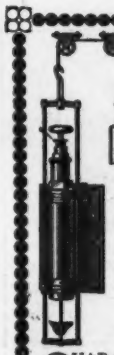

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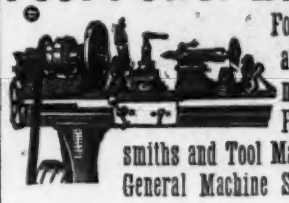

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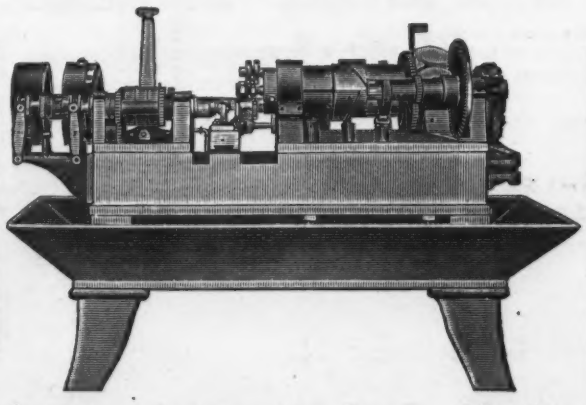

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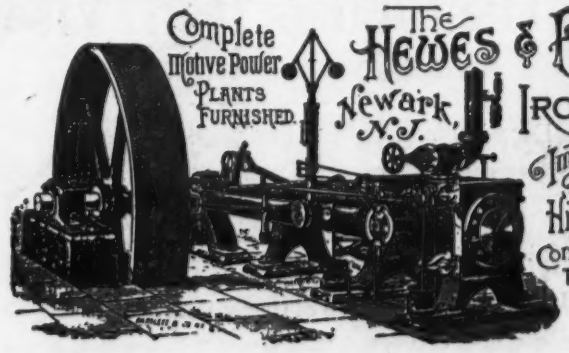

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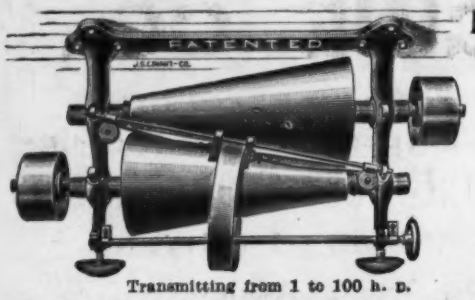

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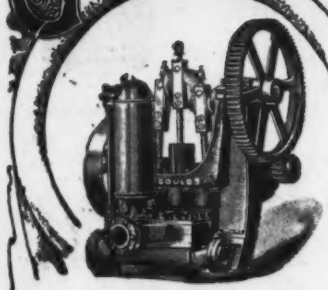

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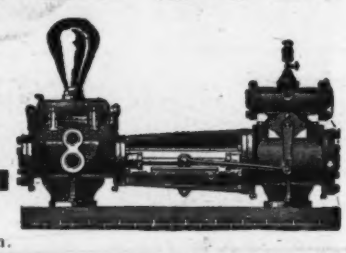

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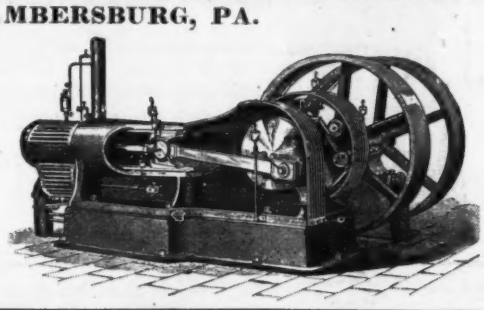

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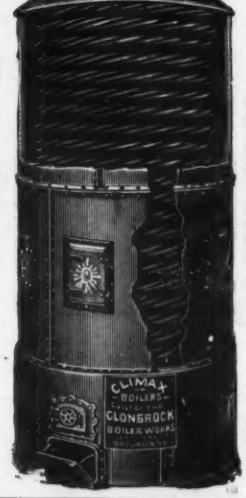

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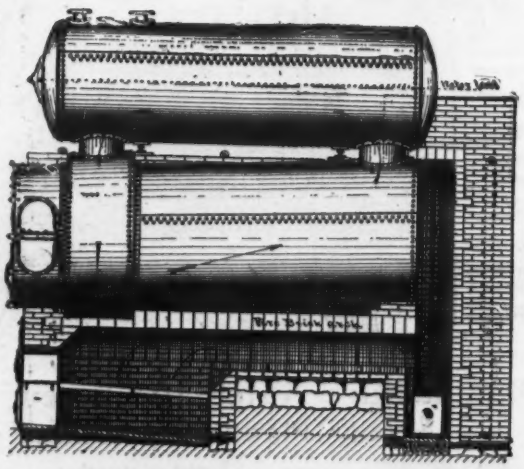

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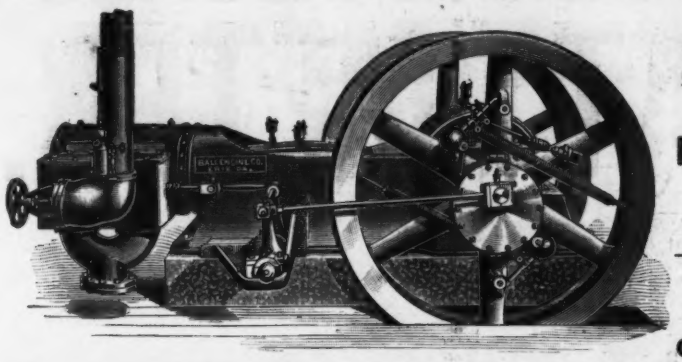

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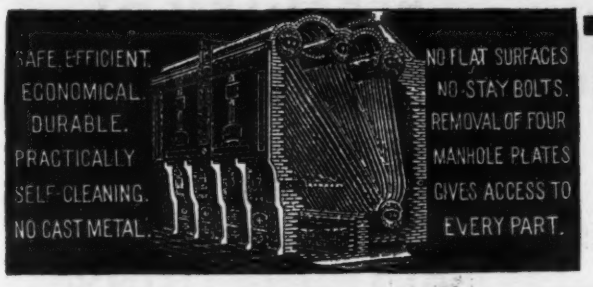

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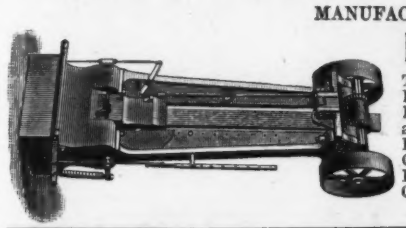

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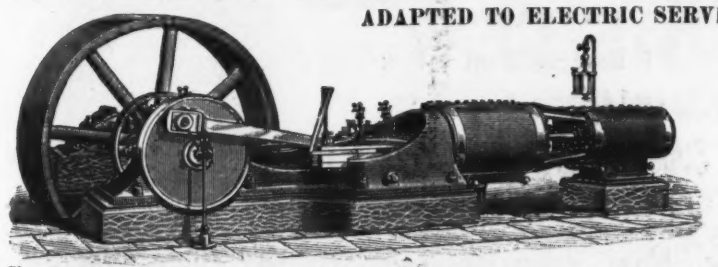

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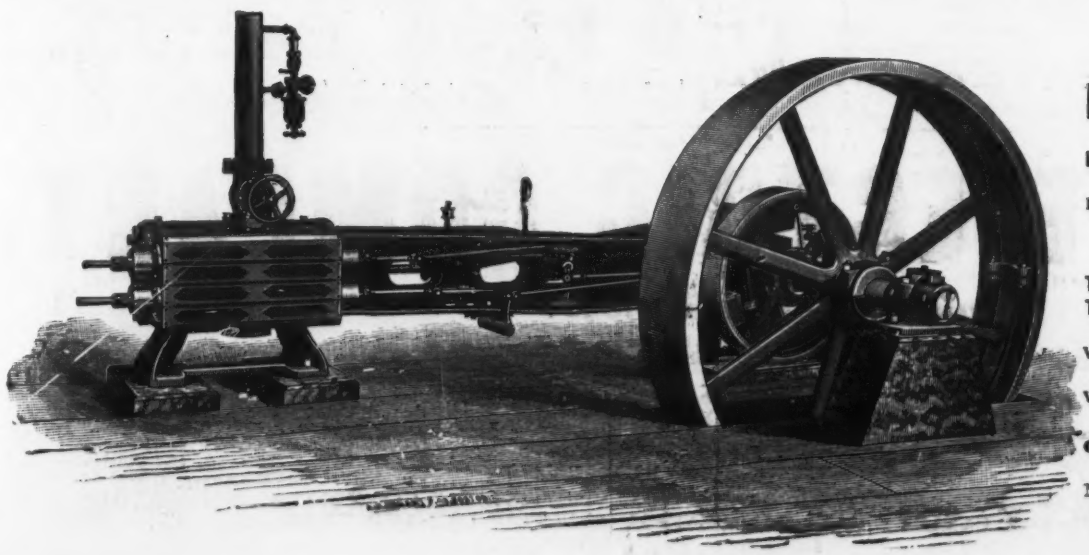

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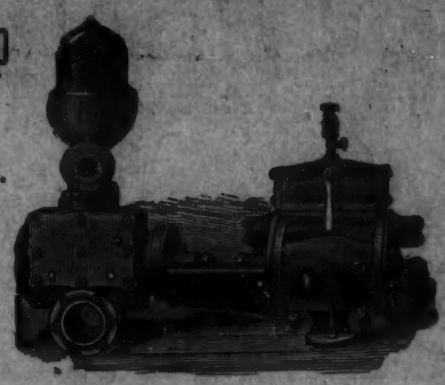

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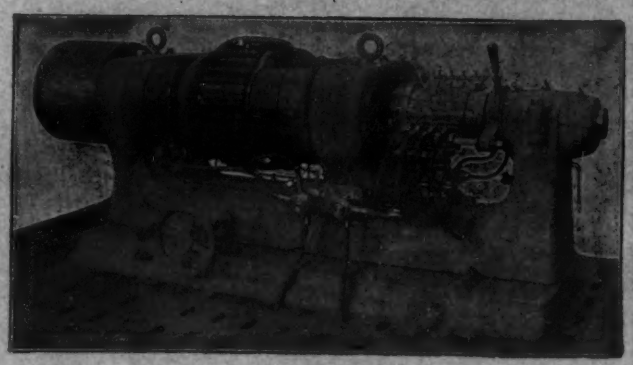

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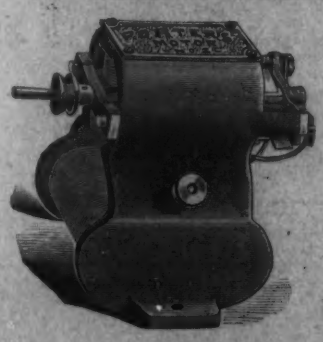

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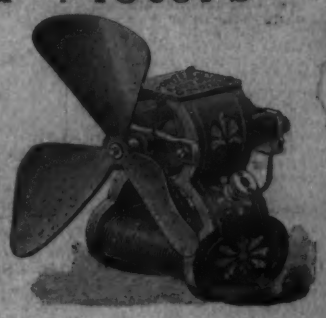

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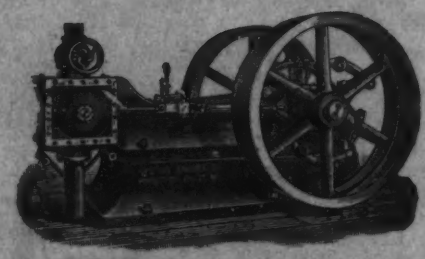

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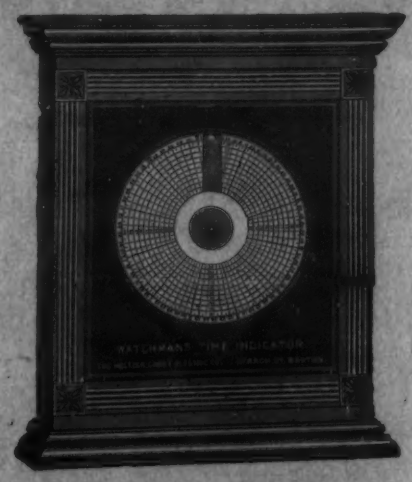
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